MODERN PLASTICS

APRIL 1959

How to decorate molded plastics for sales and profits *page 91*

Two new tests reduce guesswork in premix molding *page 124*

Look what happens when you add a pinch of permanence

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MODERN

• THE PLASTISCOPE

Section 1 . . . . . **39**

Section 2 . . . . . **208**

What's happening in the plasticizer market (p. 208); Why Mylar continues to grow (p. 45); Avison's plans for polypropylene film (p. 39); New entries in the polyethylene pipe derby (p. 43); Where does polyvinyl fluoride film find application? (p. 45); Another high heat resistant acrylic (p. 45).

• EDITORIAL

Appliances—new front for attack on plastics **246**

U/L bulletin 484 threatens to wipe out 150 million pounds of plastics sales per year. Read what has been happening so you can make the important decisions that will be necessary.

• GENERAL

Decorating molded products **91**

Molders have found that new decorating techniques, plus refinements of old ones, pay off in reduced product costs and higher profits. Many processors have established fully integrated decorating departments. Here are a number of case histories that tell you what's being done today in this field, how, and why.

Why premix for pump? **97**

Price for molds was slashed from $14,000 to $5600 when glass-reinforced polyester premix molding compound was chosen over die-cast aluminum for several important centrifugal pump components. Several property advantages were also achieved. Here are the details.

Foam chair frame is two-thirds lighter, five times stronger **98**

Revolutionary concept of furniture construction almost completely eliminates use of wood in frames, thus permitting wider design latitude. Production and transportation economies result in medium price for furniture previously available only in expensive lines. Read step by step summary of production techniques.

Savings up to 75% **100**

When this vending machine company decided to redesign its units it got a better product at a lower price by switching a number of components from metal to plastics. Involved are modified acrylic, styrene copolymer, melamine, polyethylene, vinyl. This is the complete story of what they did and how much they saved.

Plastisol molds for fancy "stonework" **104**

How do you get handcarved masonry at realistic cost? This becomes a troublesome question when an addition is planned to a stone building erected when labor costs were low. One company found the answer in casting concrete in plastisol molds. Savings are enormous over handcarving, substantial over wooden molds that had previously been used.

Why latest batteries have plastics structures **106**

Three manufacturers turned to a variety of plastics materials when they designed improved batteries. What each material contributes to better performance and why it was specifically chosen is detailed in this article.

The urethanes grow up—Part 2 . . . . . **109**

Thanks to a tremendous variety of formulations, almost every end use industry can find profitable applications for these versatile foams. In addition to outlining this vast range of use, the article describes the structure of the urethane industry, a knowledge of which is essential to the full utilization of this product.

Look what they're doing **58**

PVC and ABS for Air Force lab (p. 58); Braille checkers (p. 58); Clear castings with new epoxy resin (p. 58); Folding doors (p. 170); Double bucket (p. 172).

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PLASTICS*

APRIL 1959
Volume 36 Number 8

• ENGINEERING

Working with polycarbonate resin 115

Here are practical operating data on injection molding, extrusion, machining, finishing, and bonding of this new thermoplastic. An invaluable guide when you get around to working with this material—and chances are that time is not far off. *By E. F. Fiedler, W. F. Christopher, and T. R. Calkins.*

How to measure uniformity and predict molding characteristics of polyester premixes 124

At long last, here are convenient techniques which the molder and formulator can use to establish quality standards of premix compounds. They also provide a shortcut to evaluating new experimental compounds with less dependence on costly trial moldings. *By Allan F. Torres and Seymour S. Feuer.*

• TECHNICAL

Behavior of reinforced plastics at very high temperatures—Part 2 137

What plastic composition is best for operation at 23,000° F.? This question is of major interest in missile design. Recent tests reported in this article give the surprising answers, which are at complete variance with results that had been obtained at temperatures around 6000° F. *By I. J. Gruntfest, L. H. Shenker, and V. N. Saffire.*

Mixed polyamides containing piperazine 150

The Signal Corps was looking for wire and cable jackets with improved flexibility and outdoor aging characteristics. They found several very promising nylon formulations and are reporting on them in this article. *By C. W. Hamilton and M. M. Epstein.*

• DEPARTMENTS

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• THE COVER

Photomicrograph of actual chemical reaction occurring when acid and alcohol combine to form a polyester compound. Four-color plates, Allied Chemical Corp.

Coming up

Lead article for May will deal with a range of spray guns for use in laying up reinforced plastics. While the comparative efficiencies and economies are a source of argument there is no doubt that they will be an important new tool for reinforced plastics molding . . . Also an article on portable food freezers made of plastics with plastics foams for insulation . . . And a new method and market in molding decorative aggregate-polyester surfaces on concrete blocks, giving them the finish of ceramic tile . . . Engineering Section in May will feature another in the series on how to overcome premix molding problems . . . Technical Section will present the latest developments in vinyl plasticizers . . . June lead will cover many methods of manufacturing large containers out of polyethylene, everything from 15 gallons to 1000 gallons . . . July lead is the first of a series of two or three articles on the epoxies with a deep analysis of present and upcoming markets and the place of the compounder in the whole picture.

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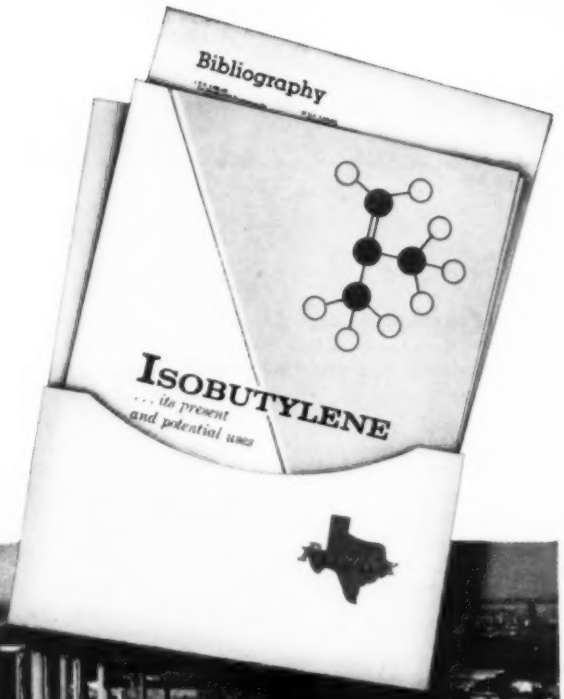

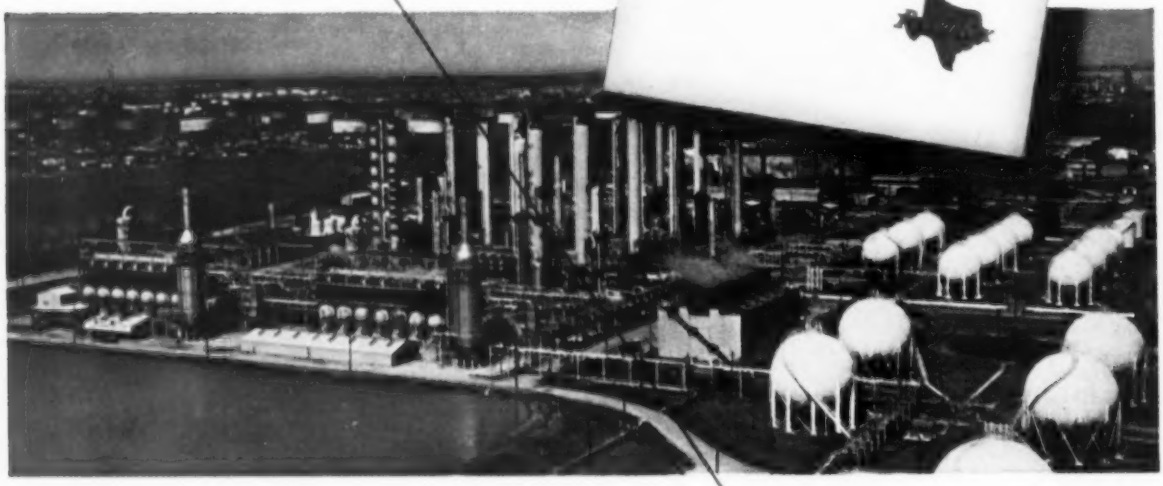

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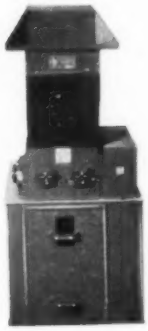

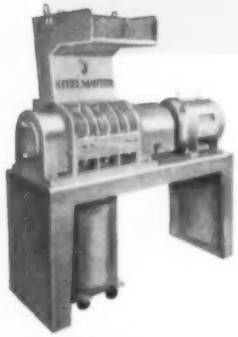

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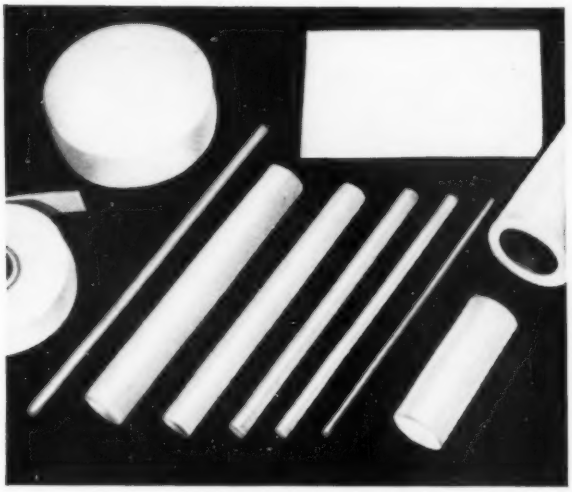

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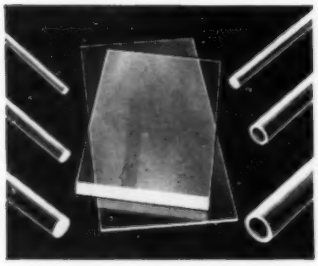

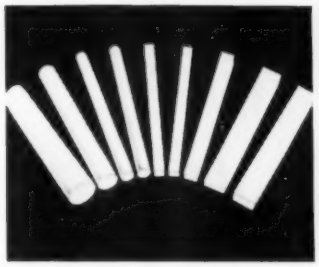

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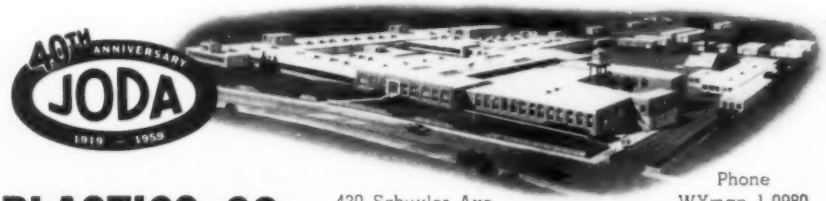

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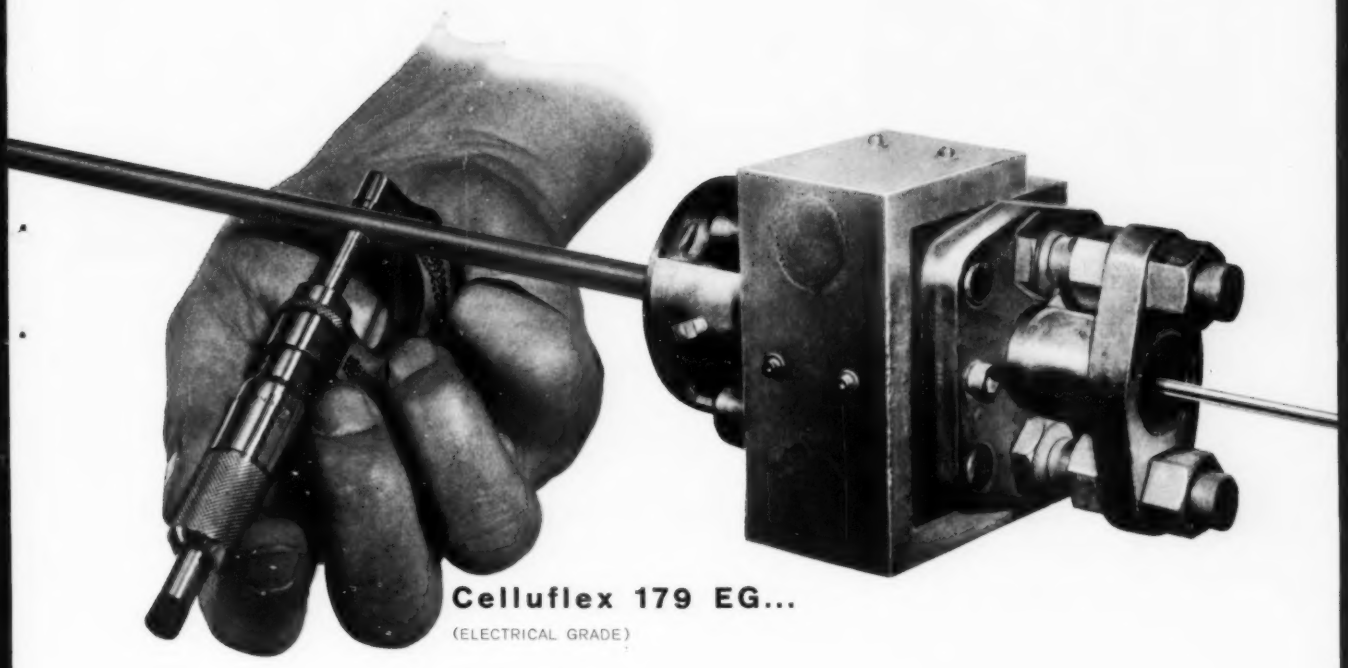

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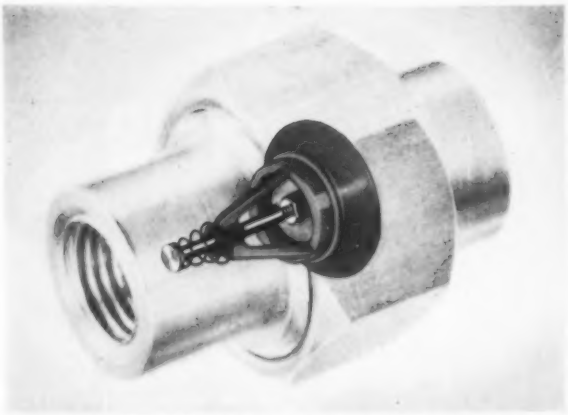

CHECK VALVE redesigned to use a valve body of ZYTEL nylon resin reduced the number of parts from 10 to 6 and cut their cost by 68%. Operation was improved. Used in fuel lines, the valve is unaffected by gasoline, oils. (Molded by Hamilton Plastic Molding Co. for OPW Corp., both of Cincinnati, Ohio.)

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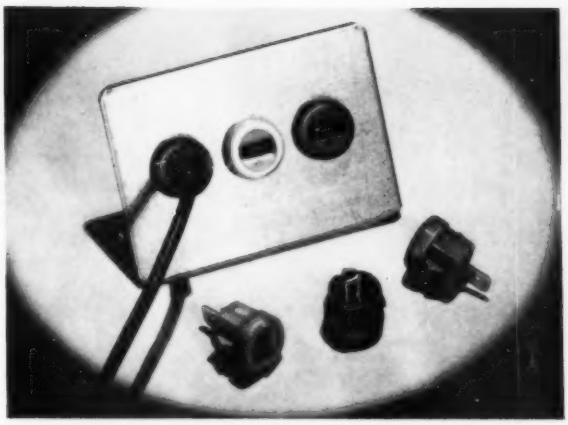

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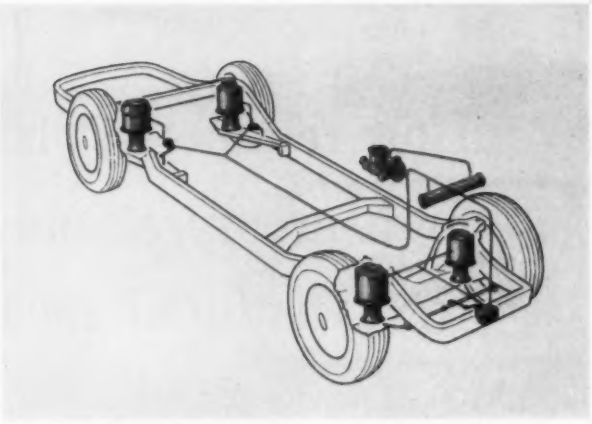

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5. Phenopregs reduce waste. This is because there is no spillage and no mold overflow.

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7. Phenopregs produce better products. Phenopregs are superior because they enable the molder to: (a) keep a uniform resin-reinforcement ratio throughout his laminate; (b) exercise strict control over the resin content; (c) control the cure because of the even dispersion of curing agents; (d) avoid defect-producing trapped air pockets or tiny air bubbles; and (e) eliminate the harmful effects of moisture . . . since the Phenopregs come predried.

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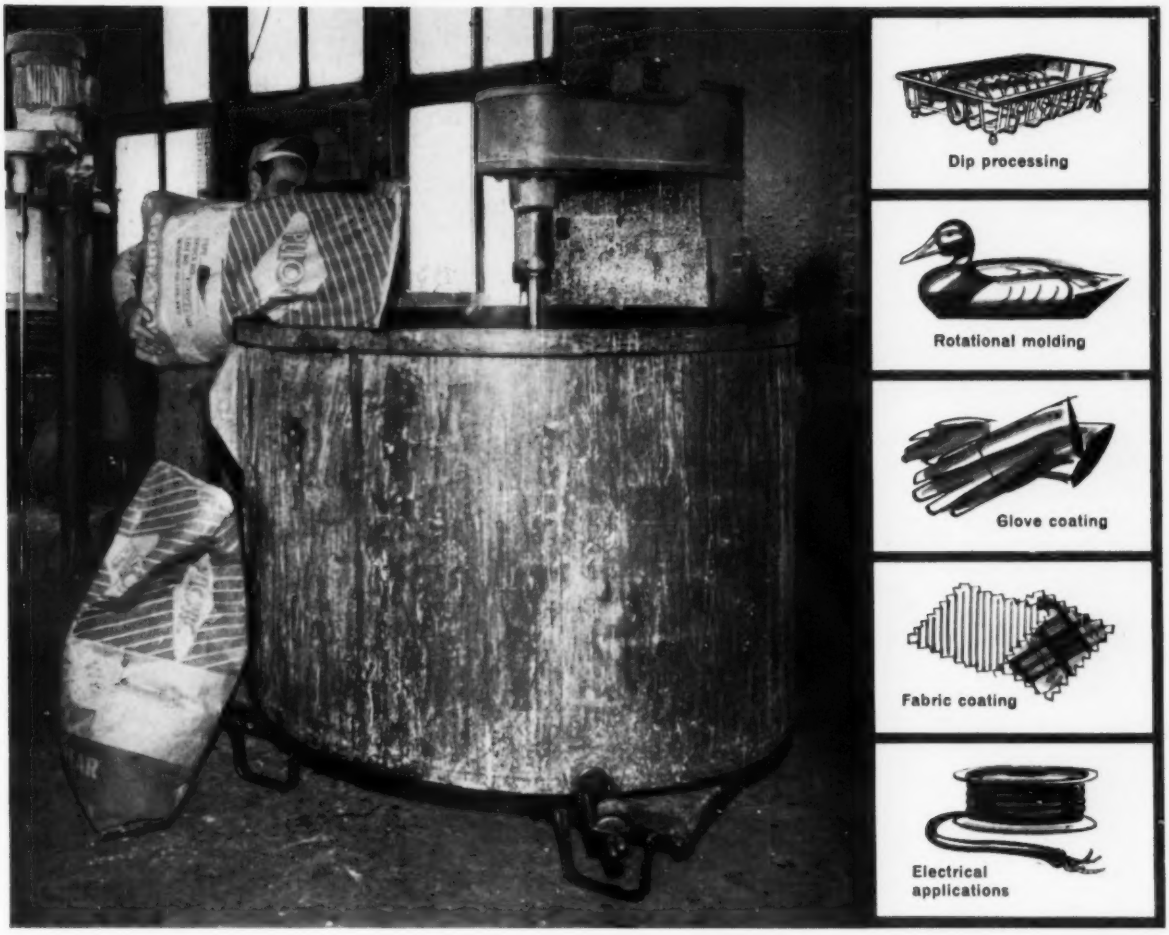

Now—a resin with high purity, wide application, handsome advantages

Consider these basic advantages imparted to plastisol compounds by PLIOVIC VO, high-purity PVC dispersion resin by Goodyear: (1) low initial viscosity, (2) greater viscosity stability, (3) very low water absorption, (4) narrow gelation temperature range and (5) excellent electrical properties.

Where can you take full benefit of these advantages? Start with dip coating. PLIOVIC VO—alone or in combination with other PLIOVIC resins—assures smooth, even build-up of plastisol on dipped surfaces and extends the useful life of the coating bath. Take rotocasting as another example. The low viscosity of PLIOVIC VO formulations provides the fluidity necessary for uniform charge distribution within the mold.

Other big potentials for PLIOVIC VO: In glove and fabric coating compounds where superior adhesion and excellent physical properties are required. Moreover, PLIOVIC VO can be made into compounds with electrical properties equal to electrical grade extrusion resins.

Pick your application for PLIOVIC VO and we'll provide the exact information you need. This service is yours for the asking—along with latest *Tech Book Bulletins*. Simply write: Goodyear, Chemical Division, Dept. D-9422, Akron 16, Ohio.

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CHEMICAL DIVISION

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The use of unsaturated polyester resins made with Oronite Isophthalic provides plastics products with greater physical strength with no increase in weight, better resistance features, greater retention of strength and appearance under and after stress and exposure to time, temperature, water, chemicals and weather.

These improvements have been proven in actual experience at reasonable cost and without need for design or process changes. Fiber glass reinforced plastics employing Oronite Isophthalic based resins are gaining wide acceptance in both structural and non-structural equipment and accessories. Other new applications include adhesives, sealing and filling compounds and special coatings.

WRITE FOR bulletin, "Oronite Isophthalic Applications—Unsaturated Polyester Resins." Formulations and resin samples are also available from Oronite for your evaluation. Just contact the Oronite office nearest you.

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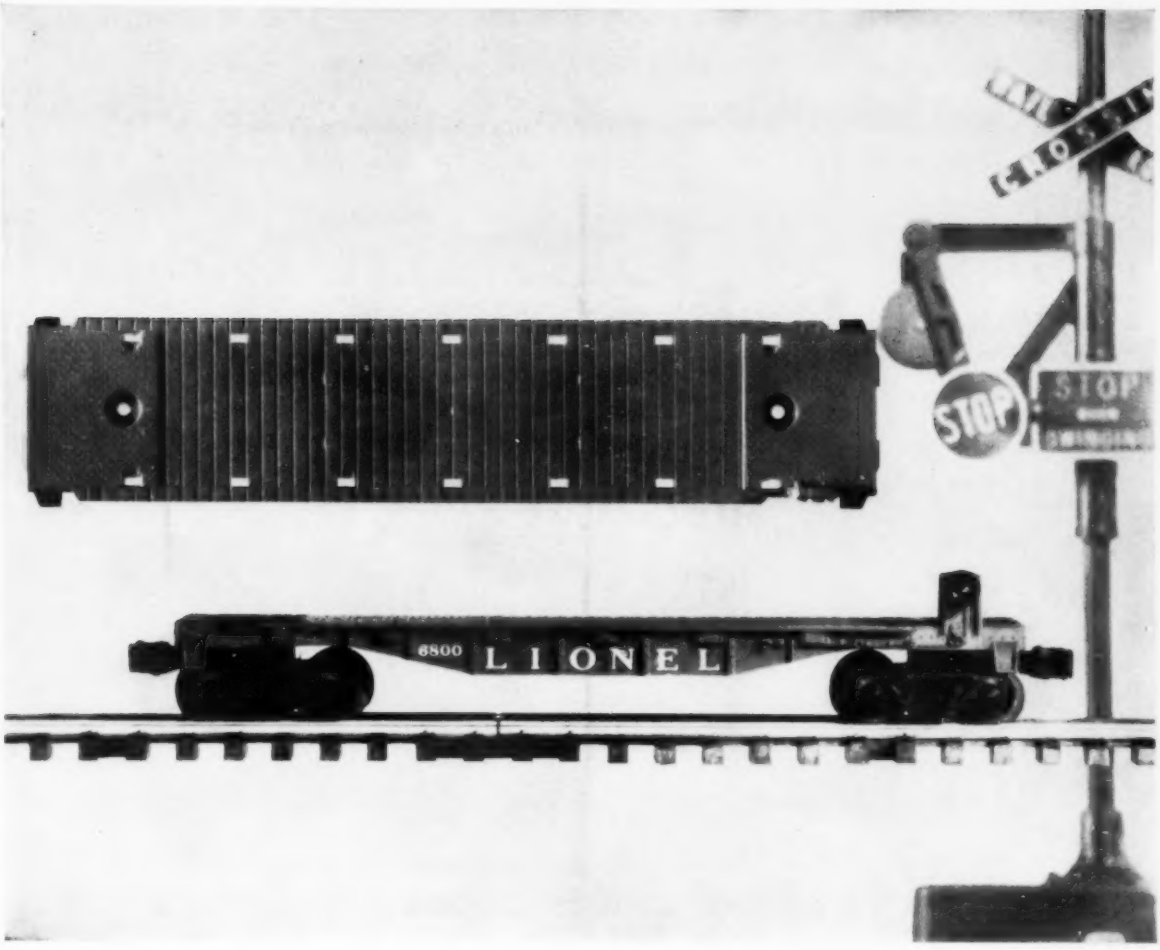


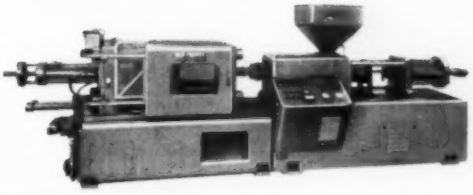
REED JETFLO cuts cycle time 50% on LIONEL flat car mold

This Lionel flat car, normally produced on a 8/10 oz. injection molding machine, was molded on a REED JETFLO '6' during a recent mold evaluation run. Result: the JETFLO cut the molding time in half with a proven increase in product quality.

The REED JETFLO, through more efficient, faster plasticizing and lower molding temperatures, provides the molder with these 3 important time and money saving advantages:

- faster molding
- higher, more uniform product quality
- dry coloring without premixing

Your shortest route to more profitable production is through the JETFLO's high-speed, low-cost molding. For complete details, call your REED Sales Engineer today.



ACTUAL MOLD TEST RESULTS COMPILED BY THE REED JETFLO '6'

ITEM	MATERIAL	NO CAVITIES	CONVENTIONAL MACHINE MOLDING CYCLE TIME	JETFLO MOLDING CYCLE TIME
Tail Lens	Crystal Acrylic	2	37 sec.	19 sec.
Eye Glass Frames	Butyrate (Hard Flow)	4	27 sec.	14 sec.

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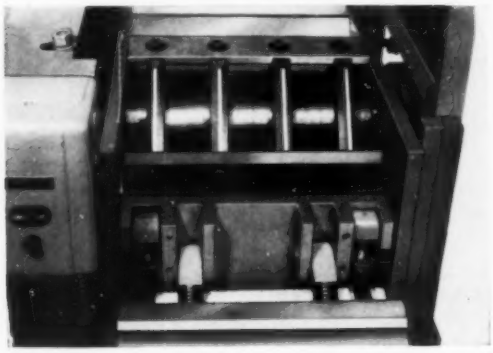

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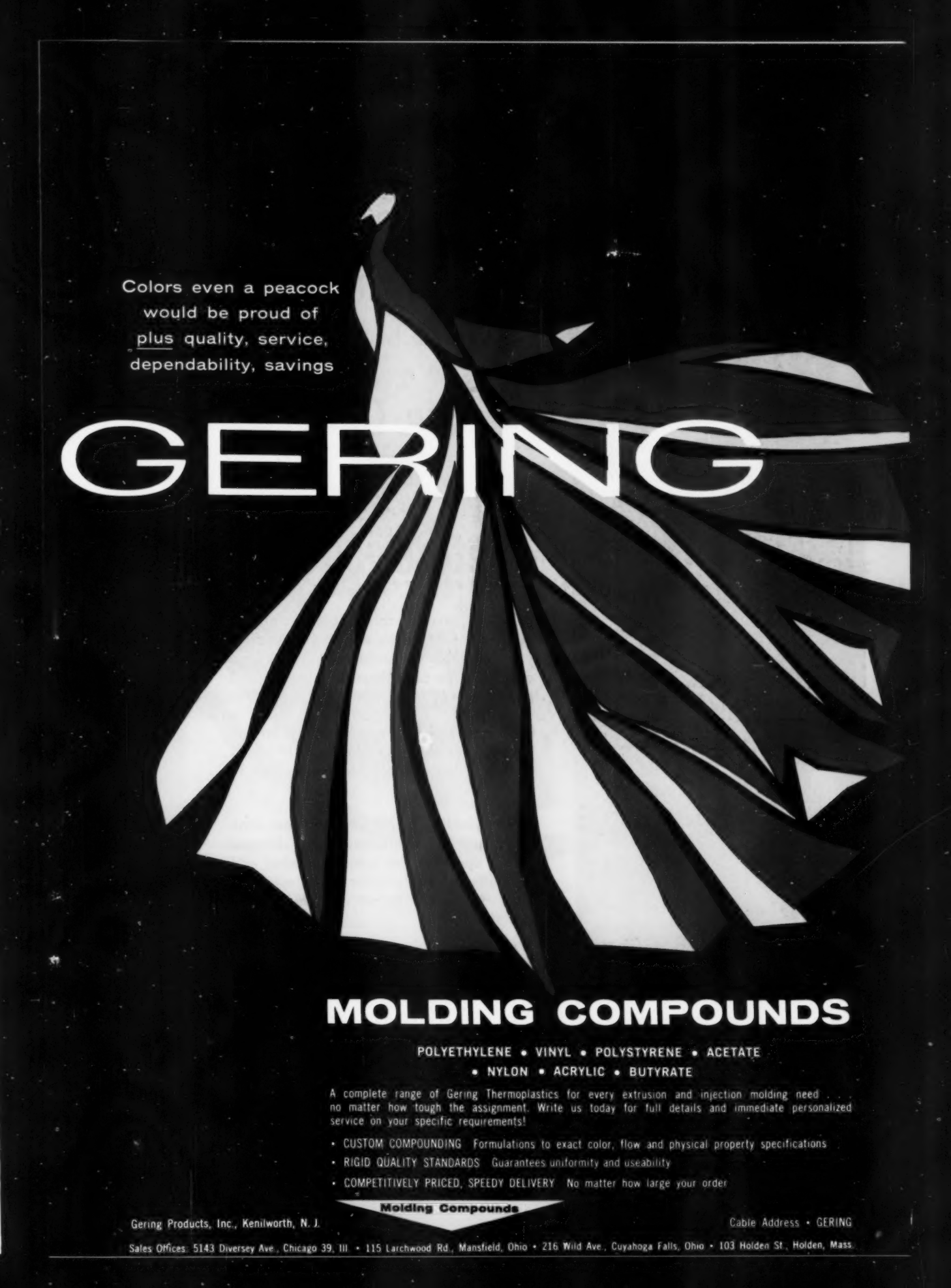
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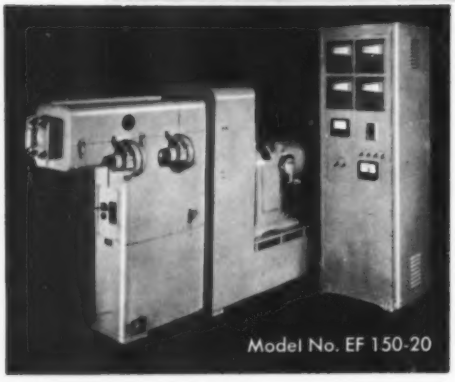

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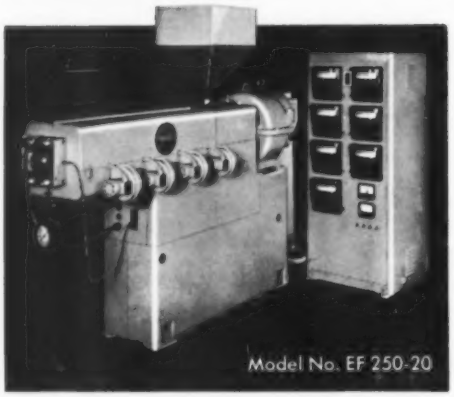

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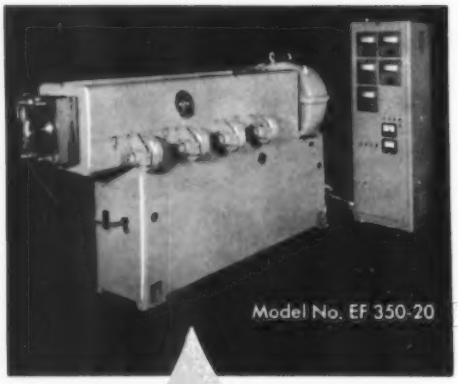

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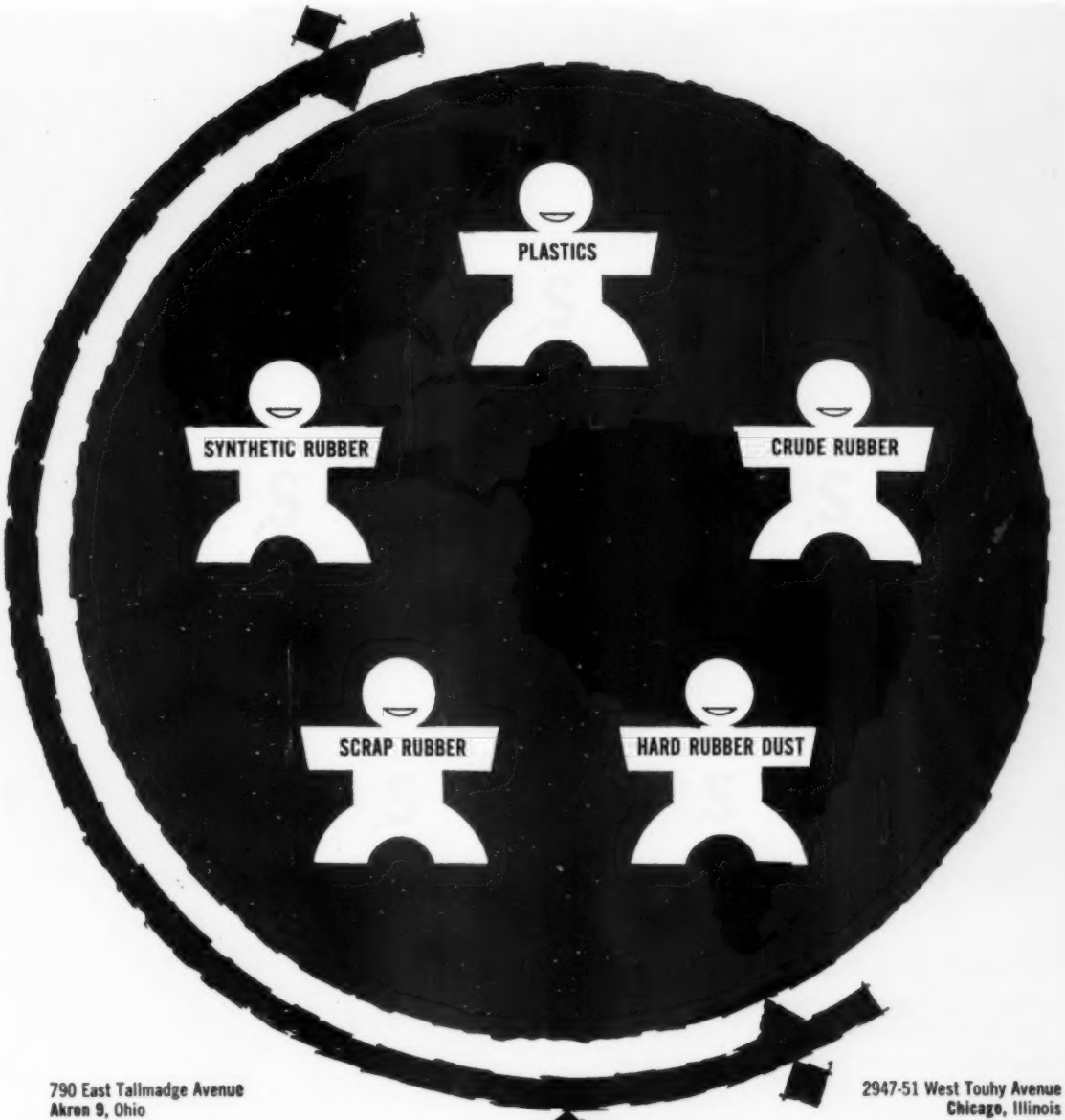

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Admex Product-of-the-Month

Light but Rugged WEATHERPROOF FOOTWEAR IN ATTRACTIVE, LONG-LASTING VINYL BY MISHAWAKA

For its quality vinyl footwear carrying the famous BALL-BAND label, the Mishawaka Rubber Company uses Admex vinyl plasticizers. The result is a light, attractive boot or galosh that wears well and stays waterproof, flexible and comfortable for years.

Manufacturers who use ADM's Admex 746 for roto-casting or slush molding like the way it not only improves product quality but also assures good handling characteristics during production.

The finished product gains permanence and color stability because Admex 746 is a stabilizer as well as a plasticizer. This means important economy, too, because Admex can replace part of the stabilizer.

Admex 746 is non-migrating and resists extraction by water, detergents or household solvents. Vinyl products made with Admex retain the desired degree of flexibility longer.

For samples and data on how Admex 746 or another of the Admex plasticizers can help solve your vinyl problems, write today.

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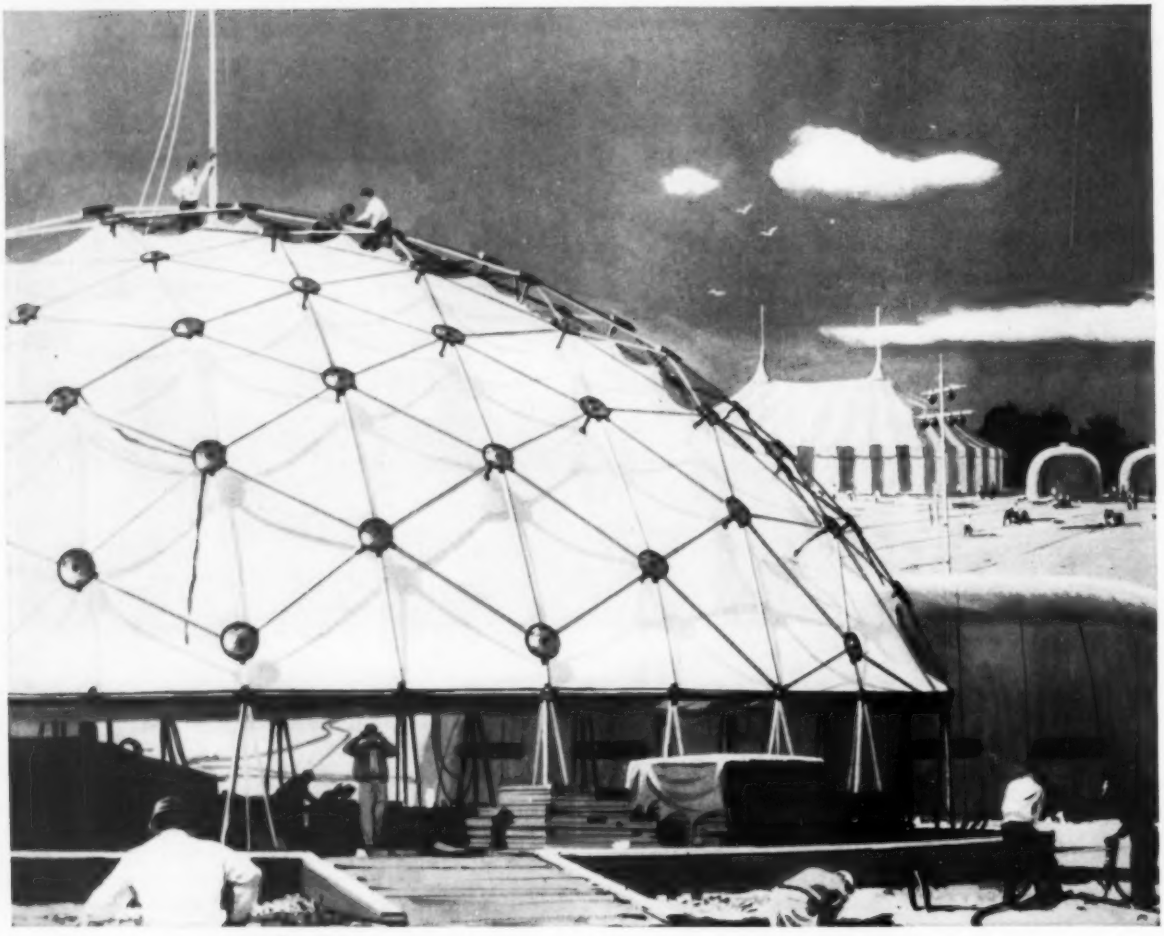
• *"Geodesic"* structure is made of vinyl coated "Welkote," Wellington Sears nylon fabric engineered for vinyl and neoprene coating. Fabric is suspended from its rigid framework —no interior posts or supports.*

*Pat'd by R. Buckminster Fuller



"Inside-Out" Building— made with fabric

Fabric does it: a new kind of building, with its skeletal structure on the *outside!* A hose, a brake diaphragm, a radome, a truck cover. Wherever and whenever new products and processes call for new fabrics for coating and laminating, Wellington Sears answers. Over a century of experience in industrial fabrics helps make the answers come more easily. Why not bring us *your* fabric problem? For free booklet, "Fabrics Plus," write Dept. K-4.

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417 SEMI-IMPACT BLACK
476-A AGITATOR BLACK

Designed and recommended for the production of components for domestic clothes-washers and dishwashers . . . such as agitators, pump housings, silverware baskets, detergent dispensers, and fittings, as well as other applications such as humidifiers, requiring similar operating conditions:

CORROSION RESISTANCE to effects of detergents, soaps and bleaches.

IMPACT RESISTANCE to reduce breakage during service should components that are handled be inadvertently dropped. (Plenco 417, minimum impact strength 0.50 ft. lbs. per in. of notch; Plenco 476-A, a similar but lower cost compound, impact strength value 0.39 ft. lbs. per in. of notch.)

SURFACE HARDNESS to provide maximum erosion resistance to abrasives.

DIMENSIONAL STABILITY to effects of elevated temperatures in washing, drying, evaporating environments.

CRACKING RESISTANCE to effects of minute but repeated surface dimensional change due to fiber moisture gain and loss and thermo-expansion and contraction. Both 417 and 476-A can be depended upon for superior cracking resistance to repeated cycling under wet-dry hot-cold conditions. Our technical staff is prepared to consult with you at your convenience about these Plenco compounds or any other molding materials or problems.

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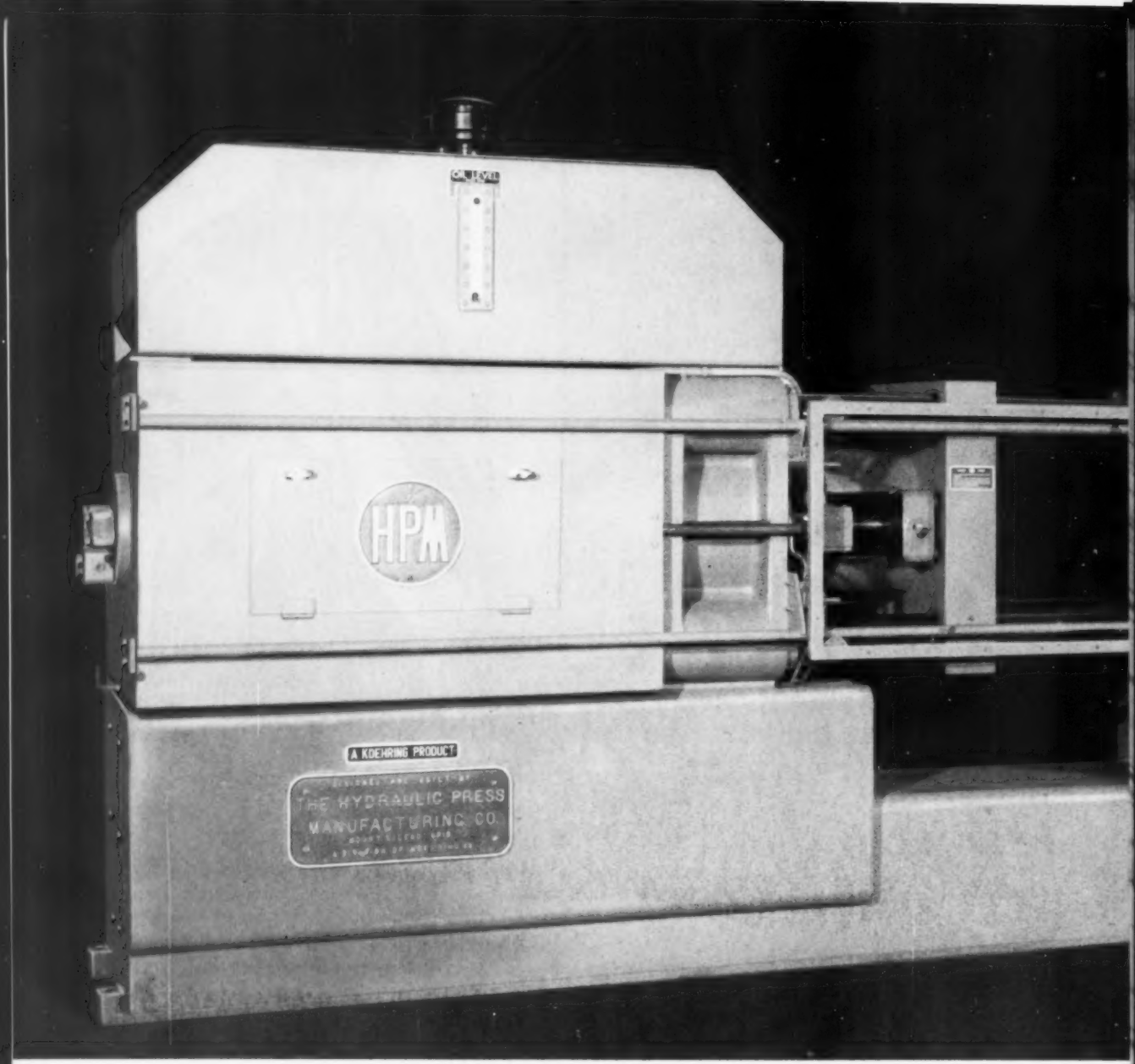


THE NEW, HIGH-SPEED H-P-M 12/16 OZ.

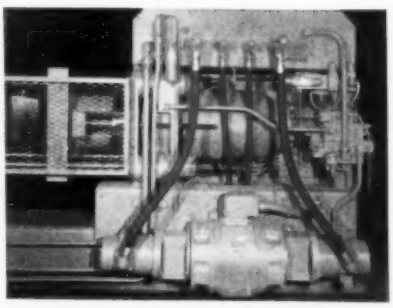
The Fastest Cycling 12 oz. On The Market

More Production — Easier Maintenance — Simpler Mold Set-up

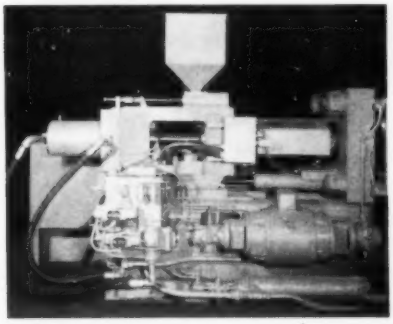
H-P-M is ready for the booming plastic market with a brand new, 1959, 12/16 oz. injection molding machine. Every feature, every operational improvement is designed for better quality parts and faster production in the 12/16 oz. range. Look at the advantages: A perfect combination of faster cycle speed with smooth, shock-free operation . . . takes molds 20″ x 34″ in either direction . . . large-area clearance beneath mold for automatic "drop-out" production . . . a full 22″ clamping stroke . . . 150 lbs. per hour plasticizing capacity . . . 1230 cu. in. per minute injection speed . . . 60 HP power unit provides from 600 to 900 cycles per hour.

INDEPENDENT CLAMPING AND INJECTION CIRCUITS

A simplified hydraulic system provides independent power and control elements . . . one circuit for clamping, one circuit for injection. Independent clamp and injection circuits allow simultaneous traversing of both clamp and injection rams thus eliminating dead time inherent in machines using a single circuit with a divert-



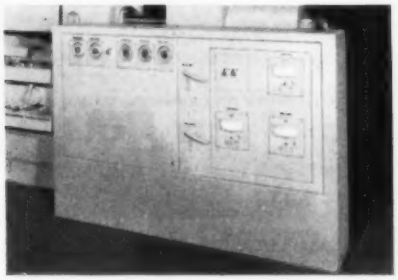
ing system. The illustration on the left shows a close-up of the clamping system . . . clean. simplified trouble shooting, isolated for complete maintenance.



ABOVE: All the controls and power elements for the injection circuit are at floor level working height and out in the open for easy accessibility.

ELECTRICAL CONTROLS AT THE OPERATOR'S RIGHT

The electrical control panel is permanently located in the position shown in the photo which allows easy access to timers and temperature controls. The panel is mounted on its own base and separate from the machine. The machine is shipped completely wired; all it takes to put it in operation is electric power and water.



THE FASTEST 12 OZ. ON THE MARKET... COMPARE IT.

MODEL 350-HV-12/16

Daylight (in.)	34
Daylight with ejector box removed (in.)	42
Stroke (in.)	22
Clamp tonnage	350
Platen size (in.)	34 x 34
Mold space (max.)	20 x 34
Plasticizing capacity (lbs.) (general purpose polystyrene)	150
*Injection rate (cu. in. min.)	1230
Electric Motor (HP)	60

*Rates to 2110 cu. in. min. available with optional 90 HP system.

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U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

APRIL, 1958 — U.S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Packaging Show — The 28th Annual AMA National Packaging Exposition will be held this year at the International Amphitheatre in Chicago, April 13-17. Close to 400 companies will have exhibits at the show. More than 35,000 visitors are expected from every state in the union, Canada and several dozen foreign countries. Exhibits will cover the entire range of the packaging industry — machinery, materials, methods, services, design and finished packages.

Running concurrently with the Exposition will be the AMA National Packaging Conference at the Palmer House, April 13-15. Conferees will hear discussion of such subjects as top management appraisal of packaging, utility in package design and special problems in industrial packaging.

Last Packaging Exposition to be held at the International Amphitheatre, Chicago, was in 1957. Show drew visitors from all over the world.

U.S.I. exhibit at the Packaging Exposition will feature a staff of technical experts to answer questions about poly film and packaging problems. As a supplier of polyethylene resins, U.S.I. frequently has been able to make suggestions that have saved packagers the necessity of making costly changes in their operations. Packagers are encouraged to make use of this opportunity to discuss innovations in poly film packaging that have been developed in the past year. Also available at the exhibit will be new application and technical data on cast film. The U.S.I. exhibit will be at Booth No. 1133-1135.

New dual dispensing squeeze bottle is a good example of polyethylene's versatility. Poly bottle dispenses medication via calibrated dropper at one end; nozzle and valve at other end permit use as a squeeze spray. A removable base cap at the nozzle end enables the bottle to be stood on end in the medicine cabinet.

Farm produce is fresher when packaged in polyethylene liners, government researchers report. Cabbages stored in poly-lined crates were found to have lost less than one percent of their weight after a week's storage. Drying out of cabbages stored in unlined crates over the same period resulted in a weight loss of 14 per cent.

Cast Polyethylene Film Makes Big Gains As Ultra-Clear Packaging Material

First Introduced by U.S.I. at Last Year's Packaging Show

A year after it was first introduced to the industry by U.S.I., ultra-clear cast polyethylene film has firmly established itself as a leading transparent packaging material. Cast film is now being widely used to package produce, frozen foods, hosiery, even tortillas and tamales. As an overwrap, cast film is packaging bread, paper plates and towels, napkins, sheets and pillowcases. Production of cast film, now about a million pounds a month, is expected to triple by 1960. At time of introduction, cast film was produced only on laboratory scale. Now approximately six film extruders are making cast film, and another six or eight have plans to produce the film within the year.

Cast film has shown that it can compete successfully with the most popular conventional transparent films in clarity and gloss. And its price is lower than most.

In just a year since its introduction by U.S.I., cast polyethylene film has firmly established itself as a leading transparent packaging material. It is now used to package hundreds of different consumer products.

Uses Extrusion Coating Equipment

Cast film, first announced by U.S.I. at the Packaging Show in April, 1958, is made by a different processing technique than normally used in polyethylene film production. In the process, polyethylene is extruded and drawn or cast across a highly polished chrome-plated roll. This casting step greatly improves the optical characteristics of the film. An immediate and even quenching prevents the formation of haze-producing crystals in the matrix of the polyethylene, and the polished roll surface produces a glossy surface on the film.

In making cast film, choice of resin is important. U.S.I.'s and customers' experience has, in general, shown PETROTHENE 205 — with a density of 0.924, melt index of 3.0 — to have optimum properties for making bags, and PETROTHENE 239 — with a density of 0.929, melt index of 5.0 — to be best for making overwrap film. Where special property combinations are desired, U.S.I. has a variety of other resins that can be used.

Although the equipment needed for making cast film is initially more expensive, production costs are competitive with those for conventional extruded film. Production speed is the same or greater.

Polyethylene Quality Control – I

Melt Index Test Assures Uniform Molding Properties

Melt index is used widely to indicate flow rate of a polyethylene resin. Uniformity of melt index helps assure uniformity of such other resin properties as production rate, low temperature flexibility and resistance to stress cracking.

At U.S.I., melt index of every lot of PETROTHENE resin is determined in accordance with ASTM method D1238-57T. The test in effect measures the amount of heated resin that is extruded through a standard orifice at a given pressure. The melt index of the resin sample is the weight in grams extruded in ten minutes. To insure uniformity within the same lot and from lot to lot, U.S.I. routinely measures the melt index of separate samples taken from various points within each lot.

Processors interested in details of the ASTM melt index test may obtain free copies of ASTM D1238-57T by writing the Editor, U.S.I. POLYETHYLENE NEWS.

Tables Simplify Calculation of Film Thickness, Weight

A new 8-page booklet prepared by U.S.I. enables processors to make quick, accurate calculations concerning gauge and weight of polyethylene film and bags.

The booklet contains simplified tables and formulas for solving such problems as average thickness of film or bag that can be expected when density, weight and dimensions are known; number of feet per pound of film that will be yielded by a roll of known thickness and width; number of bags of a given size and gauge that can be made from a pound of resin.

Copies of the booklet, titled "Formulas and Tables for Polyethylene Film and Bags," may be obtained by writing Editor, U.S.I. POLYETHYLENE NEWS, 99 Park Avenue, New York 16, N. Y.

DO YOU HAVE a new polyethylene packaging development you'd like the industry to know about? Make it routine to send your information on new developments to U.S.I. POLYETHYLENE NEWS.

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U.S.I. POLYETHYLENE NEWS, U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corp., 99 Park Avenue, New York 16, N.Y.

2-mil cast polyethylene film made from PETROTHENE 239-27 resin has unprecedented clarity and gloss.

CAST PETROTHENE®
POLYETHYLENE

new...
clear
inexpensive

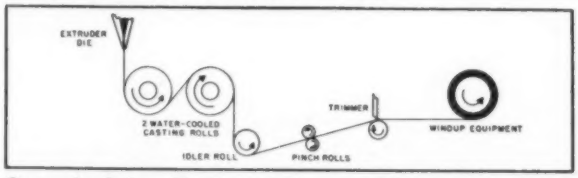
CAST POLY FILM PACKAGES IT BETTER...FOR LESS!

In a single year cast polyethylene film has become a major packaging material. Frozen food, produce, bread, hosiery, sheets, towels, paper plates . . . even tortillas and tamales are now packaged in clear, tough cast poly film. Here's why you offer your customers a better packaging material for their money when you offer them cast polyethylene film:

CRYSTAL CLARITY — PETROTHENE® cast poly film has an appearance equal to or better than that of other commonly used transparent packaging films. What's more it has a soft, natural flexibility that adds a look of quality to packaged goods.

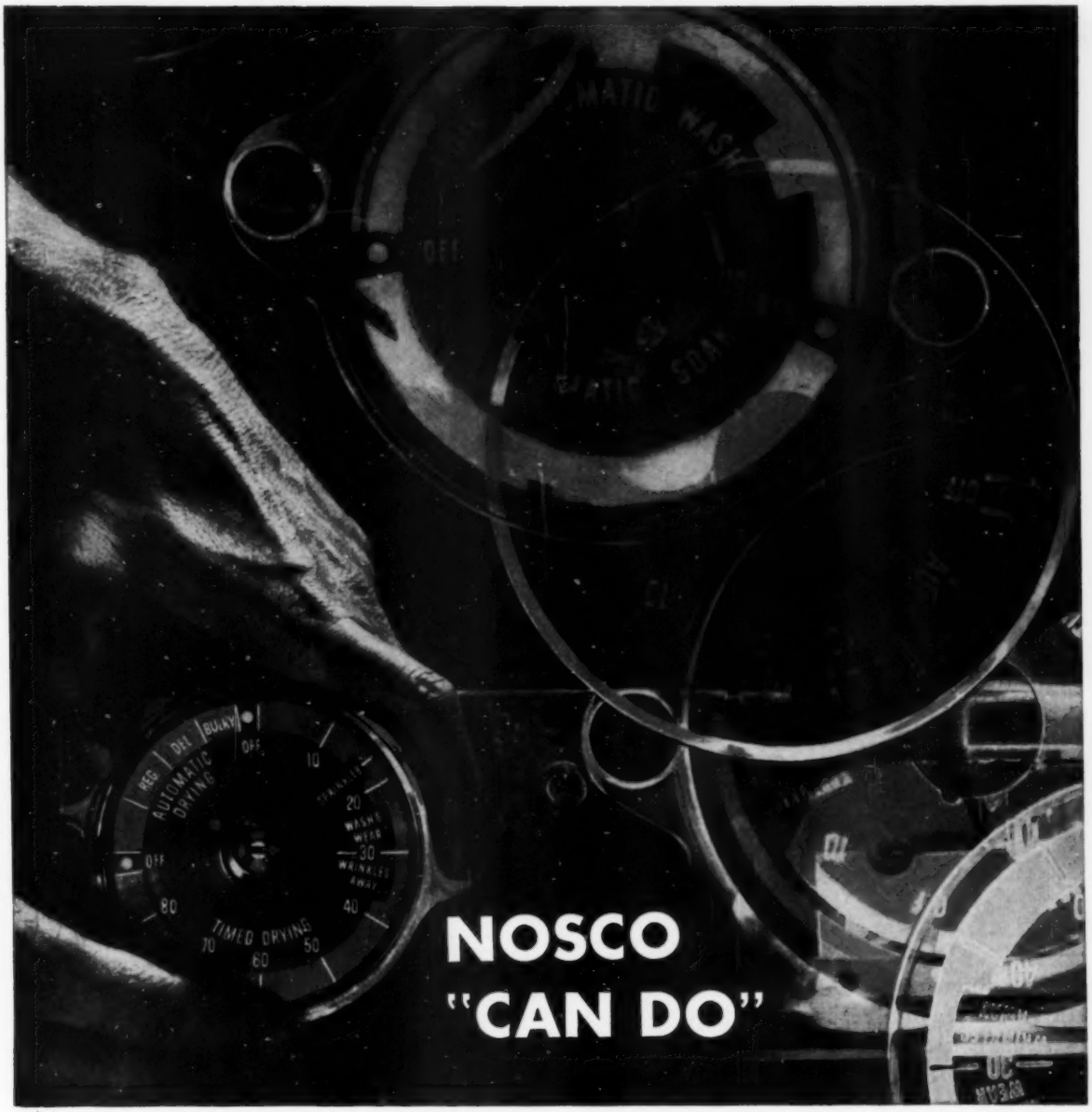
SUPERIOR PACKAGING PROPERTIES — PETROTHENE cast film has good impact and tear strength, high grease resistance and is an excellent moisture barrier. It heat seals well and is easily printed. Cast film handles well in overwrap machinery designed for conventional polyethylene film.

ECONOMY — Your customers will pay less for cast poly film than for other highly transparent flexible packaging materials—whether they figure costs per pound or per unit area of film. It is the most inexpensive high-clarity overwrap material your customers can buy.



Cast polyethylene film is made by a special process employing U.S.I. PETROTHENE resins. U.S.I. will be glad to furnish technical assistance to extruders interested in manufacturing cast poly film. Contact your nearest U.S.I. office, or write:

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.
Branches in principal cities



Redesigns decorated plastic dial . . . steps up production rate 30%

Those hands belong to a busy appliance manufacturer. That dial he's attaching to the backsplasher may be small, but it once presented a man-sized production problem! That's when he came to Nosco and said "These specs on our new decorated acrylic dials are tough. They involve a complex, cup-shaped section with remote lettering. But we still want costs kept low. Can do?"

Nosco said "Can do—better and cheaper. Let us redesign each complex dial into two pieces that are easy to mold and easy to assemble. We'll hot stamp two colors at a time. And then, with this new design we can spray paint and wipe automatically. This way, costs are cut, production increased, and quality kept high."

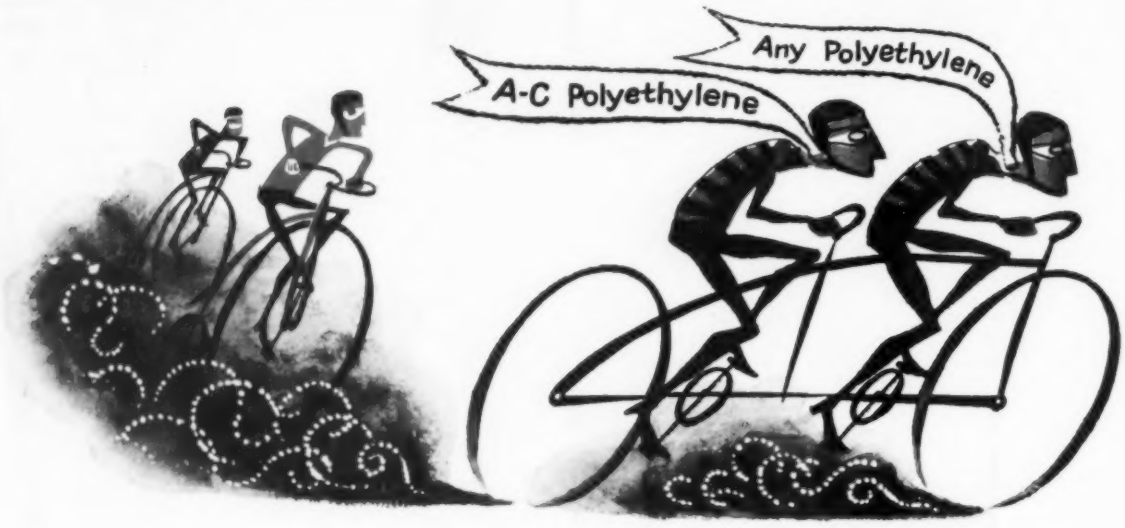
The result: 2500 completed washer or dryer dials per shift—*30% more production* at no increase in cost! That's what Nosco "Can do" did recently for one happy manufacturer.

And Nosco "Can do" for you, too. We like tough injection molding and decorating projects. Let us show you how we can produce your plastic parts in volume, and perhaps cut costs by redesign. For more information call or write.

NP-59-01

NOSCO plastics, inc. • erie 5, pa. *One of the world's great injection molders*

Blend Polyethylene with Polyethylene...



For Faster Cycles . . . Holding Low Temperature and Stress Crack Protection . . . Maintaining Quality Product . . .

blend with **A-C® Polyethylene**

See the difference for yourself! Blend A-C Polyethylene with your regular polyethylene resins, particularly the lower melt indices. Here's what happens!

You mold the same parts at lower injection pressures, using faster cycles. Stress crack resistance of low melt index polyethylene in blend is protected by A-C Polyethylene. Rejects caused by poor color dispersion are reduced. Melt index of blend is changed to a desirable, workable melt viscosity for easy mold filling. Mold sticking problems are eliminated—*even with mirror-finish molds.*

And, you can cut inventory requirements! By modifying the amount of added A-C Polyethylene you tailor the resin melt index to meet each individual molding problem. High melt index resins are no longer required. With a few conventional polyethylenes plus A-C Polyethylene you can now do the job that formerly required many grades. Production costs are lower, quality of molded parts higher, and you stock fewer grades of polyethylene.

No special equipment is required to take advantage of A-C Polyethylene. Just add to your resin during the color blending operation. Find out how A-C Polyethylene can produce better molded pieces at lower cost *for you!* Telephone or write your nearest Semet-Solvay Petrochemical office today for full information.

Allied Chemical

SEMET-SOLVAY PETROCHEMICAL DIVISION
Dept. 554-Y, 40 Rector Street, New York 6, N.Y.
National Distribution • Warehousing in Principal Cities

NOW AVAILABLE
to the Plastics Industry

the MOST COMPETITIVE LESTER EVER BUILT!

MAKE YOUR OWN COMPARISON
FILL IT IN...and see for yourself

L-225-6/9 oz.

BASIC SPECS	6/9 oz. LESTER	Any other machine
STROKE, ADJUSTABLE . .	16" to 8"	
DRY CYCLE 8" Stroke 16" Stroke	4.2 secs. 5 secs.	
DAYLIGHT	38"	
CLAMPING TONNAGE*	225 tons	
PLASTICIZING CAPACITY General Purpose Styrene	150#/hr.	
SHOT SIZE SINGLE . Styrene DOUBLE .	6 oz. 9 oz.	
MOLD CLEARANCE . . Between Beams	20" H x 17⅜" V	

*Certified by SPI Test Method

★ We invite you to test your own molds in the 6/9 oz. Lester to see what it can do for you.

These BONUS FEATURES ARE STANDARD

- Injection Cylinder Retracts for Purging
- All Valving is Panel Mounted
- Complete with 3 Die Height Spacer Rings
- Has 2000 psi Pressure System
- Incorporates SPI Standard Ejection
- Designed to Reduce Overall Height

In numerous preliminary comparative tests on production molds, the L-225-6/9 oz. Lester has shown spectacular qualities of versatility and capacity. It is bound to become a new standard for specifications in its class.

LESTER-PHOENIX, INC.

2621-1 CHURCH AVENUE • CLEVELAND 13, OHIO

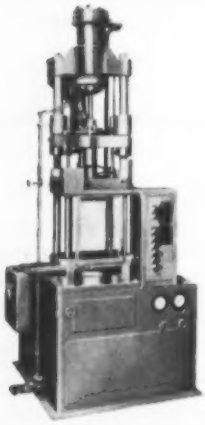
Agents in principal cities throughout the world

Watson-Stillman molding

HORIZONTAL INJECTION MOLDING MACHINES

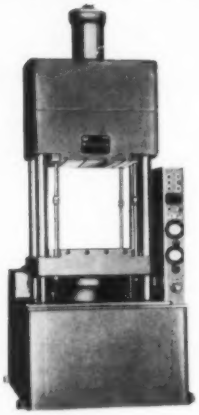
Automatic and semi-automatic, high-speed machines for molding all types of thermoplastics. Latest features assure flexibility required to mold a wide variety of compounds and intricate parts. Capacities: 5 to 500 ounces.

PE-175 . . . latest addition to the W-S line of preplasticizing-type molding machines. Available in long or short stroke designs. Capacity: 175 ounces.



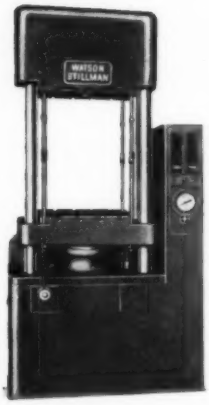
VERTICAL INJECTION MOLDING MACHINES

Designed to meet the need for low-cost high-speed production of small intricate moldings. Also well adapted to molding parts requiring inserts. Capacities: 1, 2, 6, 16, 20, 24 ounces.



TRANSFER MOLDING MACHINES

Standard four-column designs incorporating the latest features for molding thermosetting compounds. Ideal for small insert parts and cores. Adjustable opening to accommodate a variety of mold sizes. Capacities: 30 to 2000 tons.

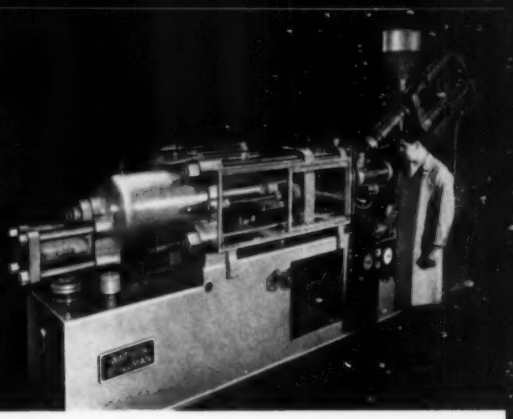


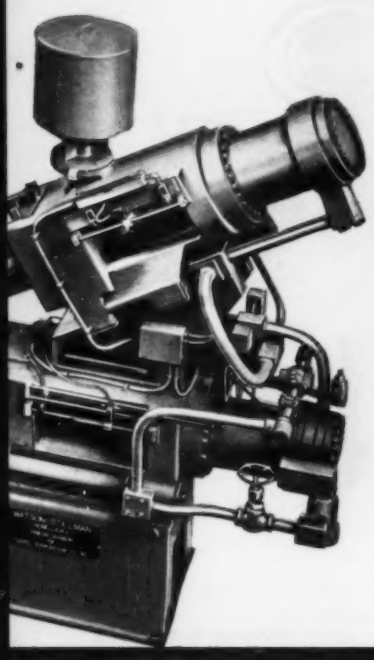
COMPRESSION MOLDING PRESSES

Can be converted to transfer press with transfer cylinder. Standard equipment includes bolsters, parallels, degassing, adjustable openings, top and bottom strippers, push-button control. Capacities: 50 to 2000 tons.

machinery

PE-15 . . . industry's first fully automatic, preplasticizing-type molding machine in a size as small as 15 ounces. Advantages: shorter cycles, better control of shot thickness and lower injection pressures.





Watson-Stillman is widely known for its "Completeline" of plastics molding machinery. From this line you can choose a model for virtually any molding requirement...a precision machine, built by specialists in molding equipment. Modern features of design assure high output at low cost.

Also available to "Completeline" users is Watson-Stillman's engineering counsel—a service which has grown out of the company's long association with every branch of the plastics industry. Whether your application requires a standard or special machine, Watson-Stillman engineers will be glad to help you discover the most economical solution.

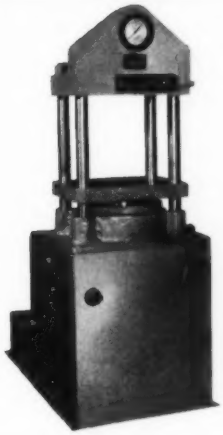
Write for quotations, or complete details on any of the equipment shown.

WATSON-STILLMAN PRESS DIVISION
FARREL-BIRMINGHAM COMPANY, INC.
565 Blossom Road, Rochester 10, New York
Telephone: BUtler 8-4600

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
European Office: Piazza della Republica 32, Milano, Italy
Represented in Canada by Barnett J. Danson, 1912 Avenue Road, Toronto, Ontario
Represented in Japan by The Gosho Company, Ltd., Machinery Department, Tokyo, Osaka, and Nagoya

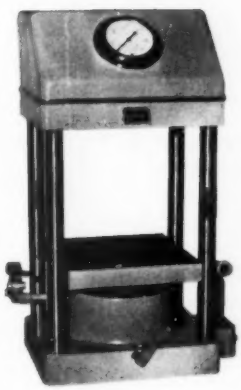
WATSON-STILLMAN®

WS-47



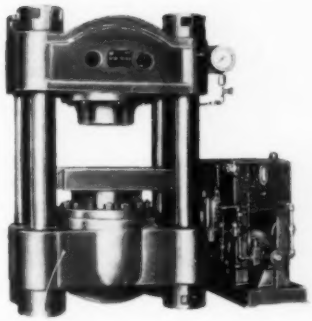
GENERAL-PURPOSE PRESSES

For molding and laboratory work, or for use as laminating press. Micro pressure adjustment makes them ideal for testing purposes. Automatic single-cycle control governs press dwell under pressure. Capacities: 30, 50, 100, 200 tons.



LABORATORY PRESSES

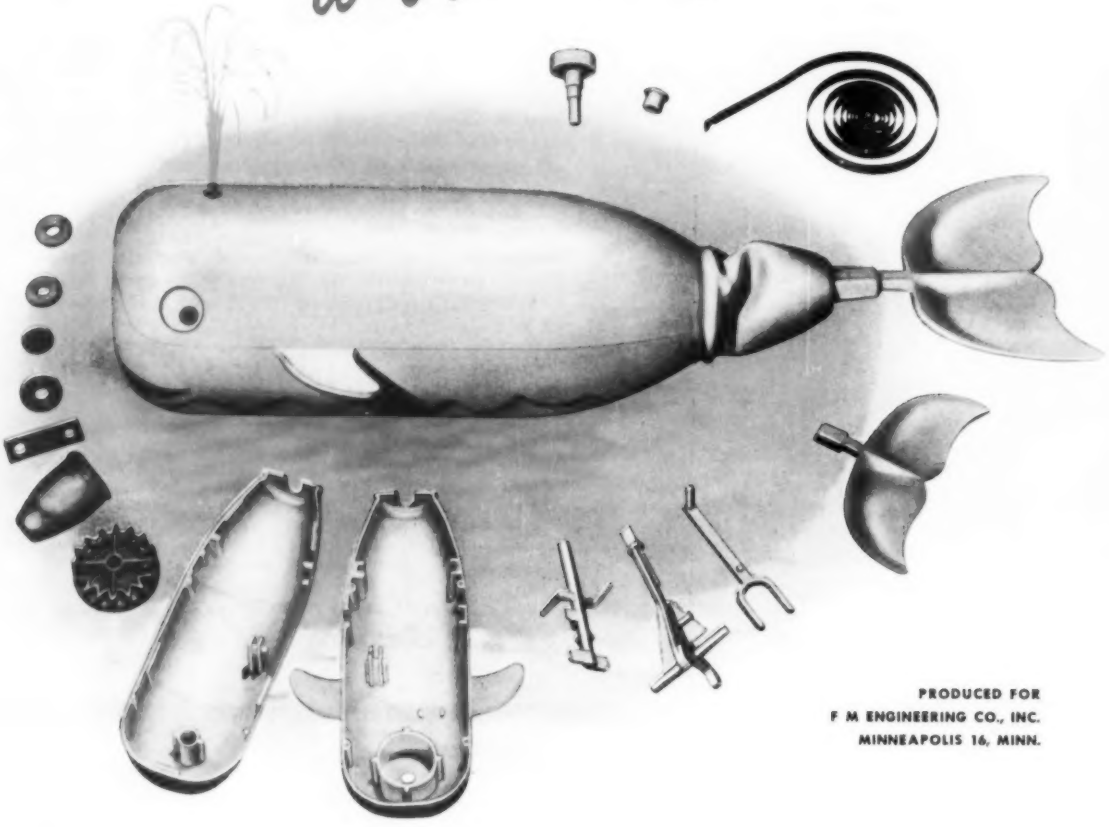
Designed for experimental work and wherever pressures of 30 to 100 tons are required on small areas. Ideal for die work, laminating and hot or cold molding. Capacities: 30, 50, 100 tons.



DIE-SINKING PRESSES

For producing dies that will meet the approval of the most exacting molder. Equipped with extra heavy platens, pumping unit, standard control valves, gauge, piping, anvil and inserts. Capacities: 200 to 3000 tons.

Spouting about a Whale of a Job!



PRODUCED FOR
F M ENGINEERING CO., INC.
MINNEAPOLIS 16, MINN.

After MOBY DICK was engineered, he turned into 16 parts — 4 metal (had to be) and 12 parts for injection molding. The proper plastic materials were selected for toughness, color, flexibility and all-around finished quality. The wind-up mechanical feature which produces the action of the toy uses what is believed to be the first all plastic escapement for a spring driven toy.

The many operations in the production of this toy required most of the specialized service offered by our company. Assembly of component parts, painting and testing along with the final assembly and packaging on a high volume mechanical basis, greatly reduced our customer's production costs and handling problems.

This is another typical example of our "START TO FINISH" service which is yours for the asking.

MINNESOTA PLASTICS CORPORATION

45 E. Maryland Avenue Saint Paul 17, Minnesota

Now—from General Chemical

An exciting new curing agent for epoxy and other resins...

BF_3 MEA

Boron Fluoride Monoethylamine Complex

Previously available as
EPON CURING AGENT® BF_3 400

Many important advantages! As a latent catalyst or curing agent for epoxy and other resins, BF_3 MEA offers distinct advantages over other commercially available hardeners. In curing epoxies, for example, BF_3 MEA offers the following major benefits:

- **Small quantities do the job.** You need only 1 to 5 parts of BF_3 MEA per hundred parts of resin!
- **Extremely long pot life.** BF_3 MEA has much longer pot life than other curing agents. At room temperatures its pot life has been as long as 6 months—compared to days, hours or only minutes for many other agents.
- **Excellent heat distortion temperature.** 300°—360°F at standard testing conditions (264 p.s.i.).
- **Excellent latent catalyst for high temperature cures.** 200°—300°F.

Many uses! BF_3 MEA has been used in casting, potting, laminating and adhesive-bonding applications with excellent results. Recent developments show that it can also be used with some solid as well as liquid resins. Other nitrogen complexes of Boron Trifluoride also offer many advantages as latent catalysts. It will pay you to investigate these new curing agents *now!*

Some Physical Properties of BF_3 MEA:

Melting point . . . . 90°—98°C.
Physical aspect . . White crystals
Solubility . . . . . Soluble in water and benzene, acetone and methyl ethyl ketone. Insoluble in chloroform. Soluble in liquid epoxy resin within 10 minutes at 85°—90°C.

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Allied Chemical

Mail coupon for technical data, samples. Attach to company letterhead, please.

BAKER & ADAMSON® Fine Chemicals
GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

☐ Please send technical information on use of BF_3 MEA and other nitrogen complexes of Boron Trifluoride in epoxy resin curing.

☐ Please send sample of BF_3 MEA.

Name_____

Position_____

Company_____

Address_____

City_____

Zone____ State____ MO-49

"I told Agatha to wear something simple!"

Some people learn only by experience. Some by brains. Fortunately for ourselves and our customers, we've learned our compression molding techniques by a goodly mixture of both.

We know what we know because we have learned our work from day to day experience . . . with just about every kind of complex molding problem under the sun . . . over 38 scholarly years.

Now, what does this mean to you? It means that today we're doing things even *we* thought were absurd a year ago . . . incredible five years ago . . . and impossible 10 years ago.

Certainly, the new compounds are greatly responsible. But it takes more than chemistry.

It takes experience. It takes ability to adapt to the latest technical short cuts. And it takes some pretty good humans, too.

Sound plausible? Well . . . we certainly wouldn't want to "stick our necks out" . . . if we didn't think so, too.

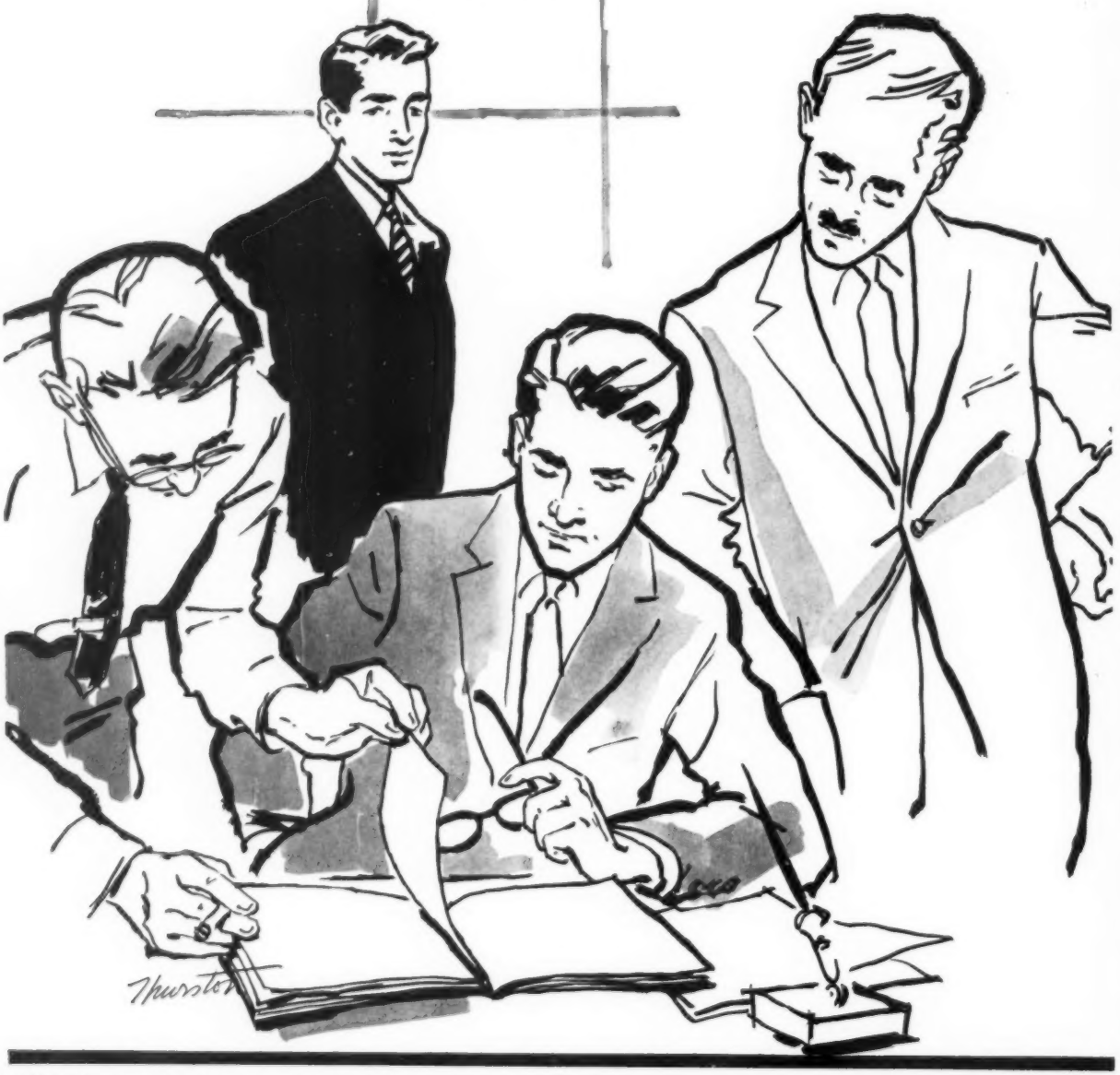
BOONTON MOLDING CO.

BOONTON, NEW JERSEY

New York Metropolitan Area—Cortlandt 7-0003
Western New York Area—Alden 7134
Connecticut Area—Woodbine 1-2109 (Tuckahoe, N. Y.)
Philadelphia Area—Pioneer 3-0315

MAKERS OF A WORLD OF
COLOR FOR 50 YEARS
Since its founding in 1909, the Standard Ultramarine and Color Company has adhered to a forward-looking attitude in its role as prime supplier to industry for high quality pigments for printing inks, paints, plastics, rubber and other products. To the thousands of customers and friends who have made possible our great growth through this half-century, we express our abiding gratitude. SUCo through its present and continuing product development will contribute to your progress will retain its customer-bestowed identification . . . . . "a job well done!"
SUCo
standard ultramarine & color co.
huntington, west virginia
SALES OFFICES AND AGENTS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

MEMO TO MEN
ON THE WAY UP



WHERE THERE'S BUSINESS ACTION THERE'S A BUSINESSPAPER

Used to be a song, back in the Thirties, titled, *Little Man, You've Had a Busy Day*. Didn't mention the Big Man. But his days are busy, too. He's the man who must make top-level decisions in business. And to make those decisions, he must have facts. All the facts. All the pertinent information he can get.

He finds time, in his busy days, to get that information. How? By getting a major portion of it from one unique source: the business publications serving his particular field.

No businessman, Little or Big, is fully informed until he reads his businesspaper. He reads it for profit, not for pleasure. He searches it through for news of the trade or industry. For facts. For fresh ideas. For new products he can put to work. And he reads the advertising with the same intense concentration he devotes to the editorial pages.

For the man on his way toward becoming a Big Man, his businesspaper is especially important. Take a tip from the reading habits of key men at every level. Take out a subscription of your own. Then, make the time to read every issue—and read it thoroughly.

WHERE THERE'S PLASTICS BUSINESS THERE'S . . .

MODERN PLASTICS ABP
575 MADISON AVE. NEW YORK 22

One of a series of advertisements prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

NEW DESIGNS IN MARLEX

Boilproof MARLEX* prune jar

sparks nationwide premium promotion!

The California Prune Advisory Board recently came up with a brand new prune preparation idea . . . the "Sunshine Jar method". To plump prunes, the housewife pours scalding hot water over the prunes, lets them cool, then puts the jar in the refrigerator. This gives her a convenient supply for everyday use. To help promote this new method a new "Sunshine Jar" was developed.

They tried china and ceramic jars, but initial cost, shipping weight and breakage were excessive. Finally, they found the ideal solution . . . a MARLEX jar! Here was a plastic that could withstand boiling water without deforming . . . freezing temperatures without cracking. The MARLEX jar is lightweight, yet extremely tough, rigid and unbreakable, with excellent gloss and color. It won't stain, and it's *economical* to produce! It adds a much appreciated touch of beauty to the kitchen or breakfast table.

This attractive jar, molded from MARLEX rigid polyethylene by Southern California Plastics, is being offered as a premium in food markets throughout the country, and in an extensive promotional campaign by the California Prune Advisory Board in national consumer magazines and on network TV!

MARLEX is excellent for housewares and thousands of other uses. Have *you* a problem MARLEX can help solve?

*MARLEX is a trademark for Phillips family of olefin polymers.

PHILLIPS CHEMICAL COMPANY, Bartlesville, Oklahoma

A subsidiary of Phillips Petroleum Company

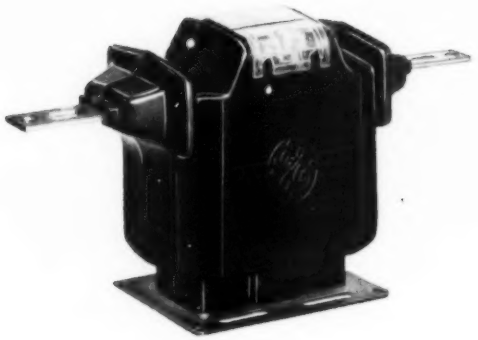
PLASTICS SALES OFFICES

NEW ENGLAND	NEW YORK	AKRON	CHICAGO	WESTERN	SOUTHERN	EXPORT
322 Waterman Avenue	80 Broadway, Suite 4300	318 Water Street	111 S. York Street	317 N. Lake Ave.	6010 Sherry Lane	80 Broadway, Suite 4300,
East Providence 14, R.I.	New York 5, N. Y.	Akron 8, Ohio	Elmhurst, Ill.	Pasadena, Calif.	Dallas, Texas	New York 5, N.Y.
GEneva 4-7600	Digby 4-3480	FRanklin 6-4126	TErrace 4-6600	RYan 1-6997	EMerson 8-1358	Digby 4-3480

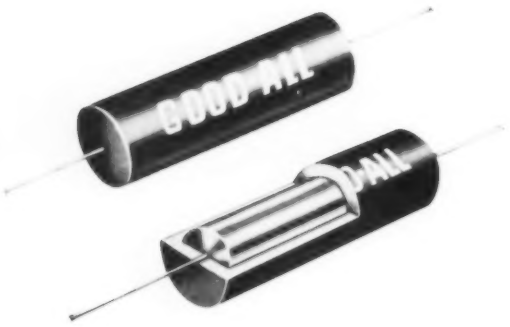
MARLEX®

Canadian General Electric Co., Ltd.

New streamlined transformers, molded in Epon resins, have superior insulation and dielectric strength. Accuracy and over-all performance are greatly improved.



Specify Epon® Resins...



Good-All Electric Manufacturing Co.

New Epon resin-molded 600 UE capacitors have superior moisture resistance. Offer rugged, trouble-free performance because Epon resin assures high dielectric strength, low leakage.

for potting, molding, sealing, encapsulating

SWITCH TO EPON resin-based compounds for potting, molding, sealing, and encapsulating to upgrade the performance of your electrical or electronic units . . . cut costs through design simplification.

Why? Because the excellent physical properties of Epon resins eliminate the need for conventional containers and housings. Size, weight, and complexity of components are reduced.

To lower costs and speed up production, manufacturers have moved in the direction of automation. In the new mixing, metering and dispensing equipment, even the most heavily filled Epon resin formulations can be used for high-volume, rapid-curing potting, encapsulating, and sealing operations.

Epon resins can be adapted to a wide variety of formulations designed to meet your specific needs. Write now for full information including a list of suppliers of Epon resin-based formulations and manufacturers of automatic mixing, metering, and dispensing equipment.

SHELL CHEMICAL CORPORATION
50 West 50th St., New York 20, N.Y.

SHELL CHEMICAL CORPORATION
PLASTICS AND RESINS DIVISION
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SHELL

THE PLASTISCOPE*

News and interpretations of the news — By R. L. Van Boskirk

Section 1 — **April 1959**

AviSun plans for polypropylene film. AviSun, the company formed by Sun Oil and American Viscose, is planning a 10 million lb. plant to produce polypropylene film at Marcus Hook, Pa. Unoriented film will be the first produced with oriented types possibly to follow in the future. Plans have also been made to immediately convert a polyethylene extruder at the American Viscose plant at Fredericksburg, Va., to production of 0.8-mil unoriented polypropylene film. Cost is expected to be lower than cellophane, since the yield of polypropylene will be around 30,500 sq. in./lb. of resin compared to 21,000 for cellophane. This film will be available for evaluation purposes.

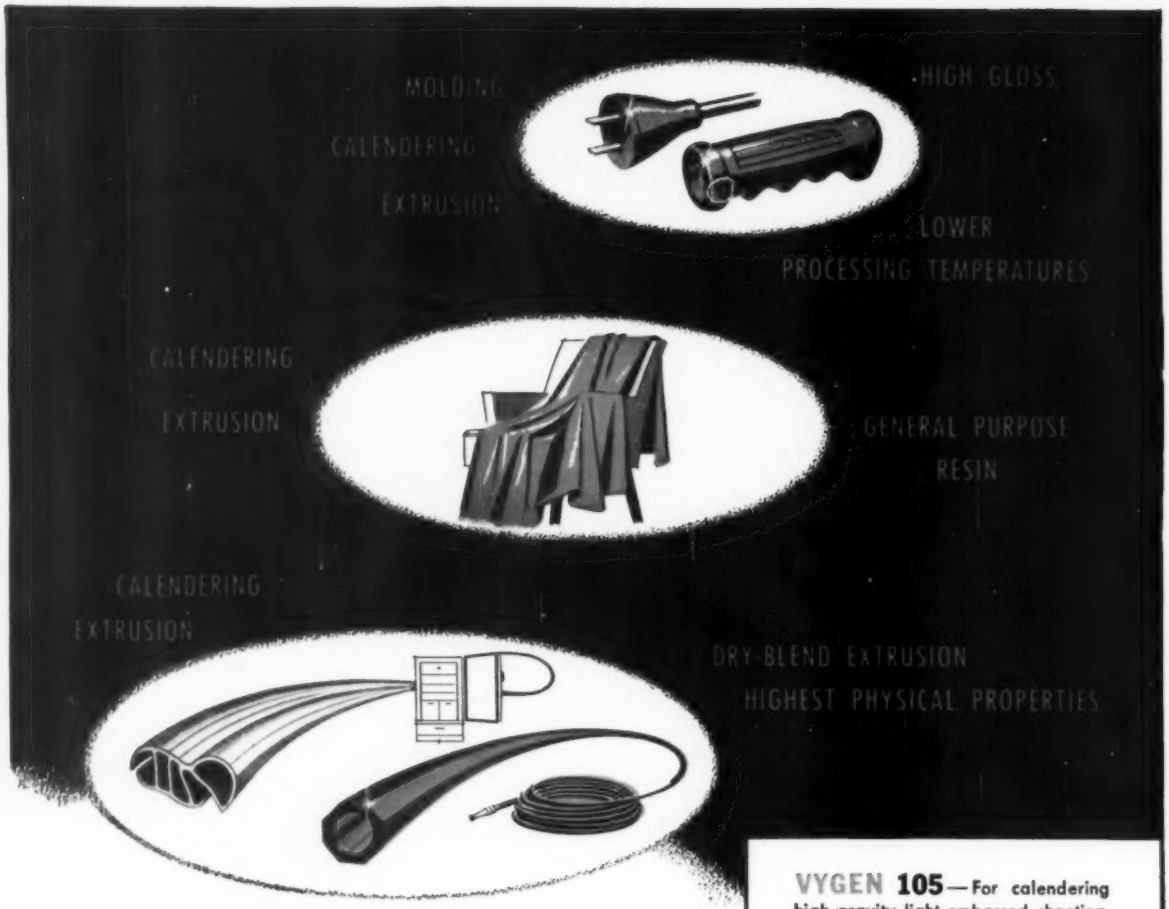
AviSun expects to have polypropylene resin available in commercial quantities for film and molding material by July or August 1959. As announced previously, the company will have resin produced at Koppers low-pressure polyethylene plant at Port Reading, N. J. AviSun has taken over half the Koppers production capacity and will boost it from 15 to 20 million lb. capacity. Koppers Engineering & Construction will handle the conversion, for which AviSun will pay $1.5 million plus rental. It is understood that this is a 2½-year agreement. Propylene monomer will be obtained from a nearby Sinclair refinery. In the meantime AviSun will plan for a 100 million lb. polypropylene plant with monomer available from a Sun Oil refinery at Marcus Hook at a cost which, it is claimed, will be significantly lower than ethylene. Dr. E. T. Severs, formerly with Natvar and Union Carbide, is product manager of the company's polypropylene activities.

Asbestos-reinforced phenolics. Specialty phenolics are claimed to be the best money makers for both producers and molders according to one school in the industry. In following this theory, Rogers Corp., Rogers, Conn., has introduced a new line of asbestos-reinforced phenolics that will withstand 250 hr. exposure to 500° F. These compounds are claimed to be lower in cost than such accepted Class H materials as silicone- and melamine-glass laminates, yet to offer the stability of asbestos-reinforced materials under conditions of higher temperature. They are not suggested as universal replacement for Class H but are adequate in many applications. The material is available in sheet laminates, bulk molding compounds, and sheet molding compounds.

Rogers also points out that the price quoted in this column last month for sisal-filled phenolic nodules was in error. The correct Rogers price is 25½¢ a pound.

Seiberling expands plastics operations. When Seiberling began operations as a plastics sheet producer on a big scale in 1955 there were doubters in the industry who thought the small market was already overcrowded. But the company's progress was demonstrated with the recent announcement that the plastics plant at Newcomerstown, Ohio would be *(To page 41)*

Reg. U.S. Pat. Off.



There's a specialized VYGEN® resin for every application

With the development of these specialized vinyl resins, General's Chemical Division is prepared to put the *right* PVC resin to work for you. All three have good heat and light stability, high-bulk density, very good clarity and exceptional uniformity. For technical assistance and detailed information on the VYGEN resin for *your* operation, just drop us a line on your company letterhead. We'll be glad to work with you on that "tough" problem.

VYGEN 105—For calendering high-gravity light-embossed sheeting, and for molded items and extrusions requiring a high-gloss finish. This resin can be processed alone or with other resins, permitting lower processing temperatures.

VYGEN 110—A general purpose, average molecular weight resin, especially adapted for easy processing of calendered film, sheeting and coated fabrics . . . also recommended for certain molding and extruding applications.

VYGEN 120—A high molecular weight resin ideally suited to dry-blend extrusion operations with monomeric or polymeric plasticizers . . . excellent, too, for calendering when maximum physical properties are desired.

Chemical Division GENERAL THE GENERAL TIRE & RUBBER CO. VYGEN

Creating Progress Through Chemistry

THE GENERAL TIRE & RUBBER COMPANY
CHEMICAL DIVISION • AKRON, OHIO

THE PLASTISCOPE

(Continued from page 39)

doubled in floor space to obtain more warehouse room, install a new extrusion line, make room for another calender line to come in soon, and increased laminating capacity. The company's sales increased from $299,000 in the first year to somewhere near $2 million in 1958 and double that volume is expected in three years.

The company has been operating on a 24-hr., 5-day week regularly, with frequent 6- and 7-day weeks. While the firm has no intention of ever entering the raw material industry, it has always been active in experimenting with new materials—as witnessed by its early entrance into the field of extruded low-pressure polyethylene and polypropylene sheets in heavy gages, which are now available to customers. Another comparatively new item is Cycolac sheet offered for football helmets, housings, and ducts. Three different grades of impact polystyrene sheet are also in production.

The company began business as a calenderer of rigid PVC and copolymer sheet, much of which was laminated in a huge press that will turn out sheets measuring 4 ft. wide, 8 ft. long and 2 in. thick. The 2-in.-thick laminates are an especially interesting item—generally used for fabrication of corrosion resistant valves, flanges and other fittings. This press is also used to bond Mylar film to metals and other plastics.

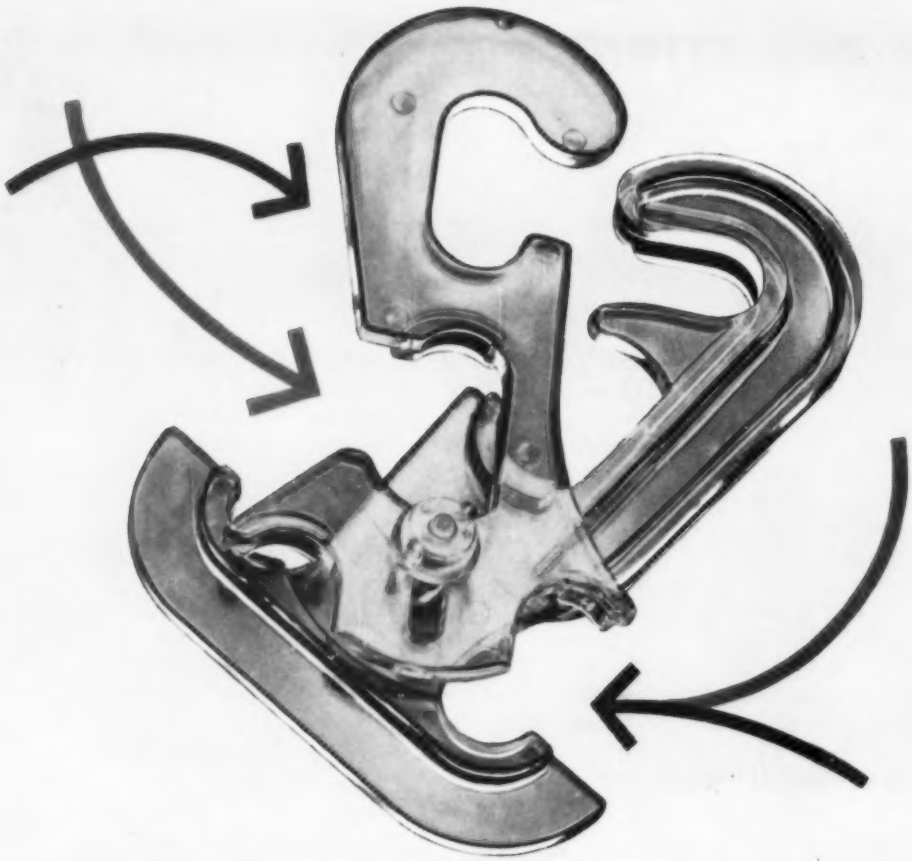
Harry M. Zimmerman is general manager of the plant, Frank Sherry is plant manager, and Carl Figenscher is sales manager.

Flame-retardant compounds. Gering Products, Inc., Kenilworth, N. J., has been quick in responding to the Underwriters' pronouncements regarding thermoplastics that burn. The company has been offering flame-retardant cellulosics and vinyls for 10 years—they are now adding polyethylene, polypropylene, and both general purpose and impact polystyrene that are specially compounded to obtain flame-retardant properties.

More high-pressure polyethylene. When U. S. Industrial Chemicals Co. recently made known that production had begun at the new Houston, Texas, plant it also made the surprise announcement that the capacity of the new plant would soon be raised to 150 million lb. from its present 75 million. The new addition will be completed by the third quarter of 1960, and with the 100 million lb. plant at Tuscola, Ill., will give the company a total capacity of 250 million lb., which U. S. I. claims will make them the second largest producer in the U. S. Executives of the company asserted that from 55 to 60% of their production is film grade resin.

The company is now producing low density (0.915-0.924) and medium density (0.925-0.929) by the high-pressure process but has also worked on high density resins produced by a low-pressure method of its own design and is studying polypropylene and polyolefin copolymers in a pilot plant.

Company officials expect that PE film consumption will be around 400 million lb. by 1964, compared to a little more than 200 million in 1958, with markets to include 60 million lb. for bakery goods, 15 million for meat; 15 million for paper products and 70 million for garment bags. PE coated milk cartons alone represent a 100 million lb. market. *(To page 43)*



This molded plastic part hangs up a record 60% savings

Could be abstract art. Actually, it's a brand new molded plastic device for hanging both low and high voltage power cables—saves up to 60% of the cost of running power through heavily timbered areas. In designing this 15¾ oz. 4-part suspension clamp for injection molding, we worked with customer engineers—adapting their design to custom molding requirements. The selection of molding material—Methyl Methacrylate—assured the right electrical and physical properties, and the ability to withstand all types of weather. This is just *one* angle of every plastic molding job. Because we mold all types of materials and offer full range (small to large) compression, injection and transfer molding facilities, we're free to make unbiased recommendations . . . to provide the material and method of most value to you. For more information, call or write.

CHICAGO MOLDED
PRODUCTS CORPORATION
1021 North Kolmar Avenue, Chicago 51, Illinois

THE PLASTISCOPE

(Continued from page 41)

Low-pressure processed-PE for pipe. Hercules Powder Co. now has available a low-pressure processed, high-density polyethylene resin for pipe, called Hi-fax 1700 E Pipe Black (density 0.945). There has been considerable controversy concerning the stress-cracking and creep properties of pipe produced from low-pressure-processed high-density PE. A higher molecular weight than normally used in low-pressure processed PE extrusion material will supposedly alleviate these difficulties but such a material is said to be more difficult to extrude. Various producers are now working on high-molecular-weight resins that are impervious to stress cracking and can be fabricated in existing equipment. The Hercules summation of the situation is that the best resin for pipe must combine the optimum in density and molecular weight, consistent with ease of fabrication and that differences in extrusion technique have a relatively small effect on pipe quality when compared to the differences in the raw materials used.

Some of the Hercules claims for its 1700 E formulation are that it is less expensive since NSF approved pipe made from 1700 E pipe black is equivalent in raw material cost to reprocessed low-density PE selling as low as 22½¢/lb.; has performed without failure for over three years; will pass the 1000-hr. tests required for conventional polyethylene of equivalent pressure rating. Over 40,000 miles of pipe equivalent to Hi-fax 1700 are in service in Europe.

Another variety of PE pipe. A customer may decide that the low-pressure-processed PE material mentioned above is just the ticket he wants when along comes a new announcement from Du Pont that makes him start scratching his head anew. For Du Pont is offering a new Alathon Super 25 PE for flexible pipe which is claimed to have withstood long-term tests for strength that equal many high-density or linear resins without having their stiffness. Pipe made from it can be coiled in 1500 ft. lengths and is offered for use in buildings subject to F. H. A. regulations.

The new resin has a density of 0.0941, is priced at 38¢/lb., and replaces Du Pont's former regular 0.937-density pipe grade. The new material employs a resin of less than 0.930 density but the carbon black used in compounding brings the density of the finished formulation up to 0.941. It has been suggested in some circles that published density of a pipe material should designate density of the compound. Thus it would become more difficult to determine the properties of PE by using density as a measuring device. This situation raises an interesting point in PE nomenclature. Supposedly when a resin is 0.940 density it is to be called a high-density resin and heretofore has automatically been labeled as a low-pressure or linear PE. But the new Du Pont material is a high-pressure compound produced of conventional PE. Its properties are obviously not the same as a low-pressure produced PE. So—we may have a high-density PE that may be either high- or low-pressure produced material or a filled material. There will be many more complications like this in the future. Therefore, it seems to this observer, that the industry may well go back to naming conventional PE as high-pressure material and the so-called high-density material as low-pressure material. It might save confusion for the time being at least. Suggestions on this subject would be welcomed by the writer.

(To page 45)

Lily white, carnation pink and all the beautiful light colors of nature's flowers . . . gradations of light to dark yellows and greens in stems and leaves . . . the translucency of membranous structures . . . these are all reproduced in plastics with the

Your choice in white pigments reflects her choice in flowers

aid of titanium dioxide white pigments. And accompanying these are textures and surfaces that seem to be nature's own. To all these things, TITANOX* titanium dioxide white pigments contribute, through uniformity of brightening, whitening and opacifying power and ease of dispersion into plastic masses and coatings too.

Whether the end product be plants or flowers, toys, gloves, tires, soles or anything involving polymers that need white pigmentation, your choice of TITANOX pigments will be right. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; offices and warehouses in principal cities.

TITANIUM PIGMENT CORPORATION
SUBSIDIARY OF NATIONAL LEAD COMPANY

*TITANOX is a registered trademark for the full line of titanium pigments offered by Titanium Pigment Corporation.

6708

THE PLASTISCOPE

(Continued from page 43)

Baker develops a second acrylic. Another in a series of higher heat resistant acrylic molding and extrusion resins has been developed by J. T. Baker Chemical Co., Phillipsburg, N. J. The new resin, designated PL-12, has a heat distortion of 240° F., approximately 40° F. higher than conventional methacrylate and 10° less than the company's previously announced PL-11. The principal differences between PL-11 and PL-12 are 1) PL-11 has optical grade transparency, PL-12 exhibits some haze as well as color in the natural resin; 2) PL-12 has much higher impact strength than PL-11. A rod pointed in a pencil sharpener can be hammered through a 1-in. plywood without breaking.

Both materials are notable for their stiffness at high temperatures. Some technicians have expressed the opinion it may be used to supersede nylon in certain applications because it does not distort under water and will withstand boiling. Samples of these two materials are not yet available for general distribution, but limited quantities may be obtained for market evaluation.

Why Mylar continues to grow. A new type of Mylar film adaptable for apparel stays has been introduced by Du Pont's Film Department. It combines improved color properties with those of standard Mylar, which has been used as collar stays on men's shirts for several years. Another interesting use for Mylar turned up in the press recently with announcement of the landing of a Mylar balloon in Metz, France, four days after its launching in Minnesota, and following the arrival of another in Spain a few weeks before. The balloons are a super-pressure type that have a skin strong enough to withstand daytime expansion of gas without bursting. Conventional balloons have valves to release gas during the day, which means their size and altitude will vary according to conditions. Unusual applications such as these are becoming commonplace for Mylar and add considerable poundage to the electrical and yarn markets that have already been firmly established since the material was introduced several years ago.

Polyvinyl fluoride film. Chemists have been trying to make vinyl fluoride a useful material for many years. When it can be controlled in the manufacturing process the resultant product has amazing longevity properties. Du Pont has now announced production of Type R polyvinyl fluoride film (first announced in MODERN PLASTICS, May, 1958) in a semi-works facility at Buffalo, N. Y., and developmental quantities are now available.

The new film is suggested particularly for outdoor and industrial applications. Early samples have not embrittled or discolored after 10 years exposure in Florida. It is usable in products requiring resistance to temperatures of from —100° F. to 250° F. It may be used for agricultural glazing, inflatable structures, electrical purposes, but particularly as a surfacing material for laminations. It can be vacuum metallized and thermoformed; should be of interest as a finish for prefabricated metal buildings and as a finish for house siding and roofing. Initial price has been established at $5/lb. Area factor is 140 sq. ft./lb./mil.

For additional and more detailed news see Section 2, starting on p. 208

MACHINERY AND EQUIPMENT

Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

Molding and extrusion equipment

The Rainkool line of refrigerating and recirculating units include three sizes rated, interestingly, by the pounds per hour of plastic material to be cooled (in the mold). Typical is the R-100, the medium-sized unit, which will cool, at 40° F., about 125 lb./hr. of injection moldings or 140 lb./hr. of material extruded into a chilled water bath. (The molding figure is based on experience with molding of polystyrene wall tiles and polyethylene housewares in molds that were properly channeled for cooling.) A return-line thermometer is included. Price: $2264 for medium unit.

Two new Foremost grinders are also available. They are specifically designed for reducing pipe and lumps. The 4-in. model handles pipe of all thermoplastics up to 4 in. O.D. The larger model, powered by a 25- to 50-hp. motor, can reduce rigid vinyl pipe up to 8 in. in diameter and ¾ in. wall thickness. Lengths from 6 to 30 ft. can be fed. This grinder will also accept extruder purgings and pipe fittings up to 7 in.

RAINVILLE large model grinder is powered by a 25- to 50-hp. motor, and can reduce rigid vinyl pipe up to 8 in. in diameter and ¾ in. wall thickness.

in all directions, through an auxiliary hopper. Cleaning is easy. *The Rainville Co., Inc., 657 Franklin Ave., Garden City, N. Y.*

RP molding press

Designed especially for molding fibrous glass-reinforced plastics, a new 285-ton press with insulated platens has a 36-in. stroke hydraulic cylinder and operates at pressures up to 5000 p.s.i. Daylight opening is adjustable to 5 feet. Total press weight is 30,000 pounds. *Remco Mfg. Co., 934 S. Main St., Willits, Calif.*

Multi-station painter

Model DVF double vertical fixture automatic spray machine is claimed to enable one operator to double the production heretofore requiring two hand sprayers. While operator unloads and loads one station, the machine is decorating in the other. If desired, small areas can be decorated in one and large areas in the other station; similarly with different colors. Either one or both stations can be operated.

Length and speed of painting stroke are adjustable. Overhead traveling guns may be tilted in one or two directions; they can also be set motionless. Standard gun mounting rods may also be employed. The square shaft vertical fixtures alternately lower and raise the part, placing it snugly in the mask for painting. Fixtures are adjustable over a wide range of parts size. The machine is entirely operated and housed in its own booth. Cylinder and air valve lubrication and water trap ejector are automatic. *Conforming Matrix Corp., 364 Toledo Factories Bldg., Toledo 2, Ohio.*

Polyester spraygun

The Polyspray M-2 is a double-nozzle spraygun that distributes catalyzed, accelerated polyester resin evenly on any surface. Mixing of the two resin streams, one containing catalyst, one containing accelerator, takes place in front of the nozzles, so there is no danger of premature hardening of the resin. Short-pot-life systems may be used. The gun has been found superior to usual pouring and spreading methods used in layup molding and has performed very well in molding train seats, window frames, machine housings, etc. Advantages claimed are: 1) up to 20% savings in resin; 2) higher glass contents (up to 35%); 3) labor savings of about 25%; and 4) cleaner, safer operation. Droplet size is large enough so that no resin fog is created and workplace atmosphere is about the same as in normal hand layup operations.

COUDENHOVE Polyspray M-2 is a double-nozzle spraygun that distributes catalyzed, accelerated polyester resin evenly.

With the gun is supplied feeding equipment consisting of two 5- or 11-gal. containers in a pressure vessel, a manually operated mixer, and control valves and gages for air and material pressure and feed rates. Up to 4 lb./min. of resin can be sprayed, with or without inorganic fillers. *J. Coudenhove, Rathausstrasse 20, Vienna 1, Austria.*

Sheet-handling equipment

These machines combine the three functions of polishing, haul-off, and shearing of extruded sheet. They are available for sheets ranging from 10 mils to more than an inch thick. The polishing rolls, of which there are three in all, may be (*To page* 48)

*Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.

Success Story for

VAN DORN

Model H-260

Port Erie Plastics, Inc., Erie, Penna., reports that their Van Dorn H-260's:—

"Save about 25% on cycle time."

"Give faster set-ups, and less waste in purging from one material to another."

"Are extremely fast, versatile and economical."

Port Erie Plastics has been operating their Van Dorn presses 24 hours per day, 6 days per week. They mold a variety of products using styrene, polyethylene, polypropylene, and nylon.

Van Dorn Model H-260's are 2½-ounce capacity presses featuring a High Capacity Heater. Other Van Dorn models have capacities from 1 oz. to 6 oz. Write for full details.

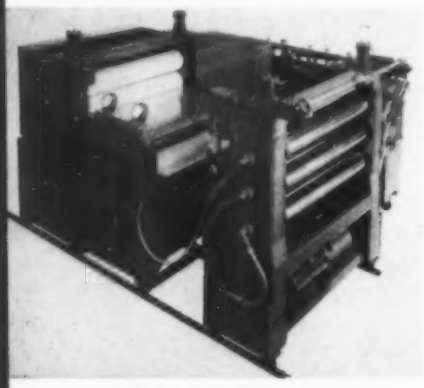
THE VAN DORN IRON WORKS CO.
2685 East 79th Street • Cleveland 4, Ohio

Van Dorn
Established 1872

MACHINERY AND EQUIPMENT

(*From page 46*)

obtained in diameters from 8 to 12 in., in any desired width, and are equipped with dial-selected speed variation from 0 to 24 ft./min. Upper and lower rolls, mirror-finished in chrome, are power-adjusted for better gage control and finish of



GOULDING machines combine the three functions of polishing, haul-off and shearing of extruded sheet.

various materials over a wide range of thickness. An adjustable, locking stop permits the rolls to be opened and returned to a pre-set position. The rubber-covered draw-off rolls are also fitted with dial-selected speed, power-adjusted top roll, locking adjustable stop. The rocker-type shear travels with sheet, provides square cut-off length. It can also be used for cutting scrap. All three components of these units are equipped with centralized lubrication stations.

In addition to the above line, a standard line is offered that is not so completely automated and is useful over a narrower range of feed rates. *Goulding Mfg. Co., 2929 River St., Saginaw, Mich.*

Volatiles tester

Control of volatiles, particularly moisture, is often important in processing and finishing plastics. Too often this is done by subjecting the materials to over-long heating and drying processes, rather than by reducing moisture to a measured safe level. The Brabender volatiles tester can take the guesswork out of devolatilizing operations. Even unskilled personnel can determine the volatiles content of small samples to within ±0.05% with this tester that operates semiautomatically. Here's how it operates: 10-g. samples are weighed into special pans, and, after any given drying cycle, the moisture (i.e., volatiles) percentages may be read directly from the instrument scale. There are 10 sample trays, so multiple samples may be processed together. *C. W. Brabender Instruments, Inc., South Hackensack, N. J.*

Die cutters

The successful development of horizontal and vertical die-handling mechanisms has led to a new model die cutter that combines both mechanisms on one machine. The maker is offering a 60- by 48-in., heavy-duty, roller die cutter with both mechanisms. The chief advantage of vertical die handling is that it precompresses and registers the stock before the roller starts cutting. This practically eliminates such usual difficulties as stock distortion and stretch, producing instead a straight-side or square cut with truly vertical edges. Cycles can be as fast as 10 sec., exclusive of loading time. Heavy-gage sheet stock can be cut, and the entire bed area is available for multiple-die set-ups. Materials that can be cut include foams, curled hair, glass mats and fabrics, supported and unsupported sheet vinyls up to 6-ply, cork up to ⅜ in. thick. *Falls Engineering & Machine Co., 1734 Front St., Cuyahoga Falls, Ohio.*

Tiny sheet former

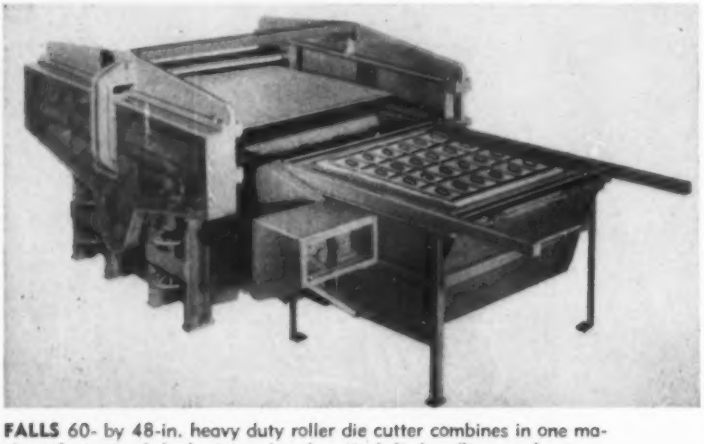
Hobby-Vac is a small, bench-type forming machine intended for hobbyists, exploratory and test work, and short-run production of small items. It incorporates a radiant heating unit, but uses a household vacuum

HOBBY-VAC is a small, bench-type forming machine.

cleaner as a vacuum source. Maximum forming area is 7 by 7 in., typical cycle is about half a minute. Price: $40. *Orbit of California, 211 Los Molinos, San Clemente, Calif.*

Rust preventive

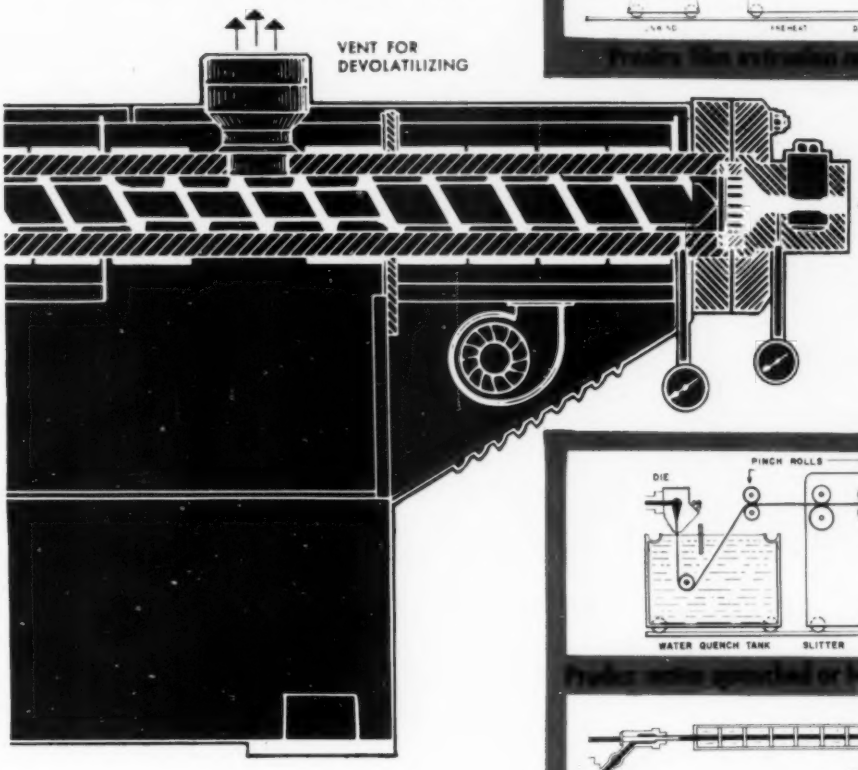
Rusting of stored molds and dies can be prevented handily with Anderol L-536 rust preventive. This material, a liquid offered in an aerosol can, offers rust protection that "far exceeds" the requirements of conventional MilSpecs. For example, steel sprayed with L-536 withstood salt spray for more than 72 hr. without failure, had not rusted after more than 720 hr. in high-humidity. One man can protect 100 sq. ft. in 15 seconds. The material is compatible with lubricants, is non-flammable, non-toxic, (*To page 50*)

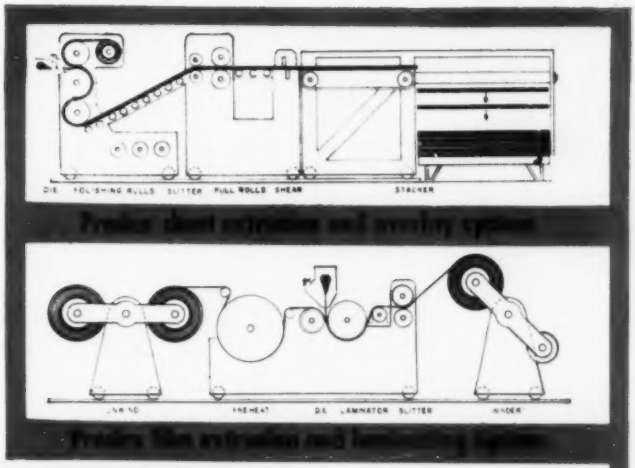


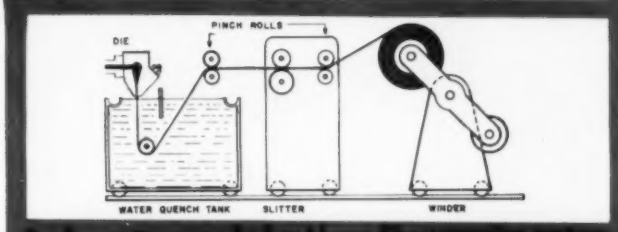
FALLS 60- by 48-in. heavy duty roller die cutter combines in one machine features of the horizontal and vertical die handling mechanisms.

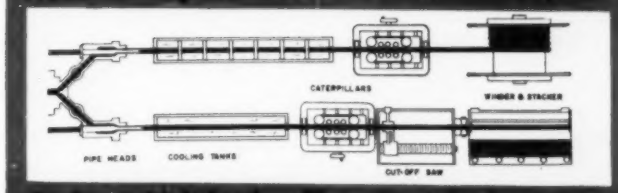
PRODEX EXTRUSION and COMPOUNDING SYSTEMS

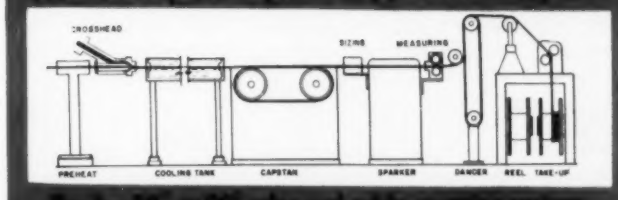
the last word in Plastics Extrusion Technology.











Designed for easier, more automatic operation and for faster capital return.

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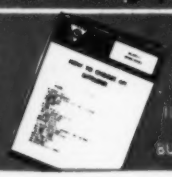
Manufacturers of Process and Extrusion Machinery

IN CANADA: Barnett J. Danson & Associates, Ltd., 1912 Avenue Road, Toronto 12, Canada



ASK FOR 50 PAGE ILLUSTRATED BULLETIN E-3

(*From page 48*)

does not irritate skin. Price: $21 per case of 12 pint cans, $2/can. *Lehigh Chemical Co., Anderol Synthetic Lubricants, Chestertown, Md.*

Water chiller

An air-cooled water chiller utilizes a closed system, permits 100% recirculation of process water, does away with water wastage, prevents build-up of scale and dirt in process lines. Two models are available: Model PT is floor-mounted, includes a water pump and tank; Model S does not include pump and tank, can be suspended from ceiling where floor space is at a premium. Either model

SAREN Model PT air-cooled water chiller utilizes closed system, permits 100% recirculation of process water.

can be had in capacities from 4.5 to 10.8 tons; units can be connected together to form a multi-unit system of any capacity. *Saren, Inc., 816 N. Kostner Ave., Chicago 51, Ill.*

Hot-gas welding "torch"

The Gee-Bee electrically heated welding torch for hot-gas welding of plastics is light in weight and well balanced to minimize operator fatigue. It incorporates a virtually unbreakable heating element that can be exchanged in seconds and has a plug-in connector. Element reaches maximum temperature within 10 min. of time that the current is switched, delivers a gas at temperatures from 280° to 300° C. (540 to 570° F.), measured ⅛ in. from the nozzle tip when the gas flow is 1.5 cu.ft./min. The 500-watt heater element will last indefinitely unless it is turned on without turning on gas. Handle remains cool, has built-in rest so that torch can be set down without burning bench. Two nozzles, $\frac{1}{8}$ and $\frac{3}{16}$ in. in bore, are supplied, and each is equipped with a knife for cutting off the welding rod. Supplied for three voltages: 230, 110, and 42; price is £11 (about $31) for the first two; £10 ($28.00) for the last. *Goodburn Plastics, Ltd., Arundel Rd., Trading Estate, Uxbridge, Middlesex, England.*

Web guides

These automatic web guides are useful in almost every application where a moving web must be accurately positioned immediately before entering a critical printing, converting, or embossing operation. Two basic types and three styles are offered: the types are vacuum-operated and hydraulic, the latter for heavier duty; the styles are the 110 for guiding the web in its present plane of motion, the 180 for cases requiring a full 180° change in web direction, and the 90 for changes from horizontal to vertical plane. Web position is controllable in all models to ±0.010 inch. In the new hydraulic types, a pneumatic-hydraulic automatic pilot receives any signal of deviation from the sensing head and translates this signal into proper corrective action. Design of this control eliminates chattering and hunting typical of some control systems. Available in a wide range of sizes and powers. *Stanford Engineering Co., Salem, Ill.*

Wire marker

Wire and cable can be rapidly imprinted by a portable electric tool weighing only 3 lb. and measuring 8.5 in. long. Primarily intended for field use, it can be mounted to a bench with a detachable bracket. Wire is marked by placing it in one of three interchangeable V-blocks and squeezing together the handles.

ACKERMAN-GOULD portable electric wire marker weighs 3 lb.

Wires from sizes 26 through 4 can be marked with inexpensive roll leaf. Price: $98.50. *Ackerman-Gould Co., 92 Bleecker St., New York 12, N. Y.*

Compression press conversion

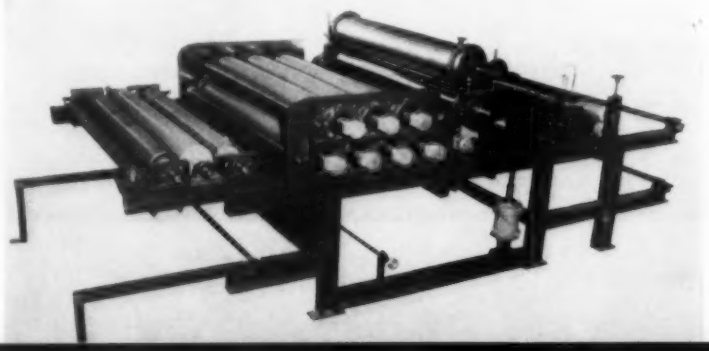
Hull-Standard is now offering to convert existing semi-automatic presses to fully automatic. Conversions are currently available for almost all Hull-Standard and Stokes-Standard presses.

Contributing to the automation of such presses is the Universal hopper-feeder which is now standard equipment on all H-S automatic presses. The feeder accommodates from one to 16 or more cavities through flexible feeding tubes, can handle family-type molds where different amounts are fed to different cavities, and can feed two or more colors at once. *Hull-Standard Corp., Hatboro, Pa.*

Laminating-embossing machines

The new Liberty laminating-embossing machines for vinyls and coated materials are more complete and compact than the earlier models. The package unit combines the following functions: heating, laminating, embossing, cooling, adhesive application, slitting, take-off, and drying. As many as 10 heater rollers may be used to develop throughputs up to 40 yards per minute. These units are especially applicable to heavy-gage vinyls and other hard-to-handle webs. All are equipped with variable-speed drives at key points to insure close control of speeds and tensions. This is reported to eliminate stretching of the web and to improve dimensional control. *Liberty Machine Co., Inc., 275 Fourth Ave., Paterson, N. J.*—END

LIBERTY redesigned laminating-embossing machines for vinyls and coated materials are more compact than earlier models.



Count on Invin® 91 stabilizer to provide crystal clarity, lasting non-yellowing in vinyls

Count on 4 important stabilizing actions from Invin 91 stabilizer, versatile liquid barium-cadmium stabilizer for clear, filled and colored vinyl stocks.

1. **Outstanding crystal clarity** — in calendered and extruded products.
2. **Unique inhibition of yellowing** — in processing, in service.
3. **Exceptional heat stability** — ample for modern high-heat, high-speed processing.
4. **Powerful light stabilizing action** — in severe outdoor and auto upholstery service.

Invin 91 stabilizer aids formulating, too

Count on Invin 91 stabilizer for two formulating benefits:

(1) Compatibility with *all* of the commonly used plasticizers – the organic ester types, the more sensitive phosphates, organic epoxides, ether esters, polyesters and hydrocarbons. Special plasticizer combinations, too, pose no serious problems.

(2) Wide choice of lubricants in addition to stearic acid . . . without regard to effect on heat stability.

Count also on minimum plate-out . . . even under difficult conditions.

National Lead Research has developed outstanding stabilizers that meet specialized problems in *all* vinyl stocks made today . . . such as high temperature service in electrical insulations; oxidation in outdoor products; color-changing impurities and temperatures in flooring; heat and light stability in plastisols, organosols. Each National Lead Company stabilizer simplifies processing, extends useful product life.

Ask us for suggested formulations and 4-page technical brochure on Invin 91 stabilizer. Ask, too, for our comprehensive 12-page catalogue of vinyl stabilizers and gelling agents.

A Chemical Development of **National Lead Company**

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In Canada: CANADIAN TITANIUM PIGMENTS LIMITED, 630 Dorchester Street, West • Montreal

U.S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

Polyamides. W. C. Hollyday, Jr. (to Esso). U. S. 2,859,208. Nov. 4. Polyamides from N-alkyl primary-secondary amines.

Polymerization. Driesback and Lang (to Dow). U. S. 2,859,209, Nov. 4. Polymerizing vinyl alkyl ethers.

Resins. S. Melamed (to Rohm & Haas). U. S. 2,860,108, Nov. 11. Polymeric sulfonamide alkyl vinyl derivatives.

Resins. G. Abel (to Rohm & Haas). U. S. 2,860,109, Nov. 11. Cross-linked acrylic anhydride terpolymer.

Resins. R. F. Leary, L. W. Bowman, and R. S. Hawley (to Esso). U. S. 2,860,112, Nov. 11. Alkyd resins from tricarboxylic acids and dibasic alcohols.

Resin. B. A. Bolton and R. E. Van Strien (to Standard Oil). U. S. 2,860,113-4, Nov. 11. Resin from polyhydric alcohol, fatty oil, benzene tribasic acid, and durene.

Resins. A. C. Hecker and W. E. Leistner (to Argus Chemical). U. S. 2,860,115, Nov. 11. Composition of polyethylene and organic phosphite.

Resin. J. E. Pritchard and P. J. Canterine (to Phillips Petroleum). U. S. 2,860,117, Nov. 11. Epoxy plasticizers for quaternized polymers.

Resins. J. C. Petropoulos and L. E. Cadwell (to American Cyanamid). U. S. 2,860,119, Nov. 11. Alkyd resins compounded with aminoplasts.

Resins. J. E. Pritchard and P. J. Canterino (to Phillips Petroleum). U. S. 2,860,120, Nov. 11. Resins of epoxy compounds and polymers of alkyl substituted vinyl pyridines.

Polymers. G. W. Stanton and F. A. Ehlers (to Dow). U. S. 2,860,121, Nov. 11. Stabilized acrylonitrile polymers and copolymers.

Cellulose esters. B. B. White and C. L. Smart (to Celanese). U. S. 2,860,123, Nov. 11. Cellulose esters.

Polymers. W. C. Lanning and M. R. Cines (to Phillips Petroleum). U. S. 2,860,125-6, Nov. 11. Olefin polymers.

Resin. A. W. Langer, Jr. (to Esso). U. S. 2,861,045, Nov. 18. Catalytic metal-modified resin.

Interpolymers. R. M. Christenson (to Pittsburgh Plate Glass). U. S. 2,861,050, Nov. 18. Interpolymers of a vinyl ester, a conjugated diene, and an unsaturated monomer.

Copolymers. J. R. Caldwell (to Eastman Kodak). U. S. 2,861,051, Nov. 18. Cross-linked graft copolymers of acrylonitrile and polyvinyl alcohol.

Stabilizer. S. B. Elliott (to Ferro). U. S. 2,861,052, Nov. 18. Vinyl chloride resin stabilized with a polyhydric alcohol and Friedel-Crafts catalyst.

Compositions. G. R. Lappin and J. W. Tamblyn (to Eastman Kodak). U. S. 2,861,053, Nov. 18. Polyolefin composition containing 2-hydroxy-4-alkoxy benzophenone.

Resins. J. L. R. Williams and T. M. Laakso (to Eastman Kodak). U. S. 2,861,055, Nov. 18. Copolyesters of a glycol and an alkylene diamine dicarboxylate.

Resins. L. M. Minsk (to Eastman Kodak). U. S. 2,861,056, Nov. 18. Resinous carboxy ester-lactones.

Polymers. S. H. Merrill and D. A. Smith (to Eastman Kodak). U. S. 2,861,057, Nov. 18. 3-and 4-(alpha-cyanocinnamido) phthalates of hydroxyl-containing polymers.

Light-sensitive film. C. C. Unruh, G. W. Leubner, and A. C. Smith, Jr. (to Eastman Kodak). U. S. 2,861,058, Nov. 18. Light-sensitive polymers for making printing plates.

Polymers. D. T. Mowry and E. L. Ringwald (to Monsanto). U. S. 2,861,059, Nov. 18. Hydrolysis of acrylonitrile-containing polymers.

Polymerization. W. E. Goode (to Rohm & Haas). U. S. 2,861,060, Nov. 18. Initiator systems for polymerization.

Polymers. W. F. Tousignant and T. Houtman, Jr. (to Dow). U. S. 2,861,-101, Nov. 18, Linear polysulfonic acid polymers.

Polymers. W. A. Reeves, C. Hamalainen, and J. D. Guthrie (to U. S.). U. S. 2,861,901, Nov. 25. Bromine-containing nitrilo methylol phosphorus polymers.

Polymers. J. E. Pritchard (to Phillips). U. S. 2,861,902, Nov. 25. Addition products of heterocyclic nitrogen polymers.

Polymerization. R. J. Kern (to Monsanto). U. S. 2,861,933-4, Nov. 25. Photopolymerization.

Polymerization. A. B. Borkovec (to Dow). U. S. 2,861,962, Nov. 25. Polymerization of olefin oxides with ferric compounds.

Resins. H. D. DeWitt (to Chemstrand). U. S. 2,861,969-70, Nov. 25. Polyester compositions.

Resins. W. Ritter, F. Meyer, and K. Demmler (to Badische Anilin). U. S. 2,861,971, Nov. 25. Hardenable resin mixtures containing a halohydrin.

Resins. K. E. Muller, O. Bayer, and S. Petersen (to Bayer). U. S. 2,861,-972, Nov. 25. Cross-linked polyester-urethanes.

Molding composition. H. Wechsler (to Borden). U. S. 2,861,973, Nov. 25. Moldable slurry of polyethyl methacrylate and liquid vinyl butyrates.

Interpolymers. J. L. Lang (to Dow). U. S. 2,861,974, Nov. 25. Interpolymers of styrene with elastomeric tripolymers.

Polymers. D. A. Gordon (to Dow). U. S. 2,861,976, Nov. 25. Haloethylene polymers stabilized with allylated dibenzoyl peroxide.

Polymerization. M. T. Harvey and P. L. Rosamilia (to Harvel). U. S. 2,861,978-9, Nov. 25. Polymerization of butadiene 1,3-furfural reaction product.

Resins. R. L. Fischer (to Cities Service). U. S. 2,861,980, Nov. 25. Urea resins.

Resins. C. E. Frank and V. L. Hansley (to National Distillers). U. S. 2,861,981, Nov. 25. Isocyanate polyester reaction products.

Polymerization. G. Mino (to American Cyanamid). U. S. 2,861,982, Nov. 25. Polymerization of water-soluble unsaturated monomers.

Polymerization. P. Fotis, Jr. (to Standard Oil). U. S. 2,861,983, Nov. 25. Using lithium catalyst for ethylene polymerization.

Cellular body. A. Charlesby and M. Ross (to U. S.) (*To page* 162)

Periodic Chart of the Atoms, Copyright W. M. Welch Mfg. Company, Chicago

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WORLD-WIDE PLASTICS DIGEST

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

Soviets listen and learn. Chem. Week *83*, 29-31 (Dec. 27, 1958). Comments from a team of Russian plastic scientists and managers after a tour of plastics plants in this country are reported.

Finger dip for fingerprints. Ind. Eng. Chem. *50*, 31A-32A (Dec. 1958). A solution of nylon is used to take fingerprints.

The adolescent plastics pipe industry. Plastics World *16*, 12, 17-19 (Dec. 1958). Statistics and uses for plastics pipe are reported.

A look at the market for vinyl acetate. Chem. Eng. News *36*, 64-8 (Nov. 24, 1958). Markets and uses for vinyl acetate are discussed. These include adhesives, coating resins, textile treatments, and other resins.

Graft and block polymerization. C. G. Overberger. Chem. Eng. News *36*, 80-85 (Nov. 10, 1958). The principles of graft and block polymerization and the types of polymers produced are compared.

Materials

Crystallinity changes in irradiated polyethylenes. A. Charlesby and L. Callaghan. Phys. and Chem. Solids *4*, 306-14 (1958). Measurements of specific volume were used to study the destruction of crystallites in polyethylene (PE) exposed to radiation. Pile radiation is much more effective than electrons in disrupting crystallites, for equal energy absorption. Larger crystals are more readily destroyed in low- and high-density PE. Pile radiation may be more effective in destroying crystallites because of the interaction of fast neutrons with hydrogen atoms.

Synthesis of n-substituted diisopropanolamines, their sebacate polyesters and polyurethane elastomers. J. L. Boivin. Can. J. Chem. *36*, 1405-09 (Oct. 1958). Several N-substituted diisopropanolamines were prepared by reacting aqueous solutions of amines with excess propylene oxide at ordinary pressure, but higher N-substituted diisopropanolamines had to be prepared in an autoclave at 200° C. Their condensation with sebacic acid gave the corresponding polyesters, which were soluble in strong acids and had molecular weights of about 1500. The hydroxyl-terminated polyesters were cured with a slight excess of 2,4-tolylene diisocyanate at 100° for two days to yield elastomers of brittle temperatures in the region of −50° C.

Molding and fabricating

Cleaning of melt-spinning nozzles by the Kolene process. R. Kuhn. Kunststoffe *48*, 555 (Nov. 1958). Chromium-nickel steels are used for the construction of nozzles employed in synthetic monofilament spinning. These nozzles may be conveniently cleaned by immersion in molten Kolene salt at 400° to 500° C.; this treatment removes all traces of organic residues.

Low temperature grinding reclaims vinyl scrap. Plastics Tech. *4*, 1122-23 (Dec. 1958). A technique is described for grinding and cleaning vinyl chloride plastic scrap at low cost.

Magnet checks tubing bore. Product Eng. *30*, 52 (Jan. 5, 1959). An instrument is described that checks rigid PVC tubing for proper bore. The unit is used as the tubing is extruded and is located between the automatic tube-cutter and the haul-off unit. Defects in tube diameter trip a signal. Tubing up to 2½ in. inner diameter can be run through this instrument.

Ultrasonic cleaning of plastic spectacle frames. D. May. Plastics Tech. *4*, 1013-15 (Nov. 1958). Ultrasonic vibration is used to clean plastic spectacle frames.

Applications

Plastics used in solid film lubricants. T. A. Dickinson. Plastics (London) *23*, 378-9 (Oct. 1958). Solid lubricants such as graphite, molybdenum disulfide, and lead oxide may be applied as dispersions in resinous binders to form conventional organic coatings with exceptional lubricating qualities. The most common types of resins in use are the alkyds and epoxies. Various applications for use of solid films in lieu of oils or greases are presented, and the coefficient of friction values are discussed in detail. The coefficients of friction of the film lubricant are independent of temperature from −100° to +600° F. The lubricants are applicable for use on such varied materials as unfilled phenolics, rubber, glass-fiber laminates, ceramics, cork, and wood.

Bone-setting with polyurethane. Adhesives Age *1*, 42 (Nov. 1958). Broken bones in the body are successfully bonded with urethane resin adhesives.

Some recent applications of high-density polyethylene. B. H. Krevsky. Wire and Wire Products *33*, 1201-4, 1274-5 (Oct. 1958). The use of high density polyethylene (PE) as an insulating material is discussed. Tree wire and service drop cable can benefit from high density PE's excellent abrasion resistance. Other applications of the abrasion resistance include its use on military field wire and as insulation on magnet wire for submersible pumps. The ability of high density PE to withstand higher temperatures than the conventional PE has led to its use in coaxial cable television hookups. It protects the conductor against intermittent high temperatures. High and low density PE are compared.

Future use of plastics in motor vehicles. R. Rajan. Plastics Inst. Trans. *26*, 415-32 (Oct. 1958). Problems concerned with the manufacture of automotive parts of plastics are discussed. It is emphasized that the amount of scrap and rejects is high.

Impact protection with foam plastics. E. R. Dye and M. D. Smith. Mech. Eng. *80*, 65-67 (Dec. 1958). Rigid polystyrene foam with a density of 1.75 lb./cu.ft. provided the best human head protection per inch of thickness. Most of the energy-absorbing foams do not have linear spring rate characteristics under impact blows. Most low-density foams tend to become stiffer with a decrease in temperature. In cases where the impact energy exceeds the energy absorbing capacity of the foam and an auxiliary absorbing structure is used, *(To page 166)*

FEDERAL PACIFIC ELECTRIC COMPANY
MAKES OWN MOLDING COMPOUNDS WITH
RCI PLYOPHEN PHENOLIC RESIN—
Amortizes $100,000 Equipment investment in 10 months

• The molding compound you see here is made by Federal Pacific Electric Company, at its Newark, N. J. circuit breaker plant. In changing over from a vendor supply system to *their own compounding shop* FPE saved enough on costs to amortize their $100,000 equipment investment in ten months.

Federal Pacific manufactures a complete line of low and high voltage electrical distribution and control apparatus and uses Reichhold PLYOPHEN phenolic resin as their prime molding compound resin. Mr. R. B. Goody, in charge of plastics research, said "the basic properties of the PLYOPHEN material are improved by our formulating. *More resistance to voltage breakdown, better mechanical stability and higher impact range are achieved by doing our own compounding work.*

"Our selection of RCI as a prime supplier of molding resins was made after years of trying to work with ready-mixed molding compounds. When these compounds were supplied from several sources, we had trouble with fluctuating costs, erratic delivery schedules and varying formula consistency. We finally decided we could simplify matters by installing our own compounding department.

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U.S. PLASTICS PRODUCTION

Production and sales figures in 1000 lb.* for the years 1957 and 1958. From statistics compiled by the U. S. Tariff Commission.

Materials	Final Totals, 1957†		Preliminary Totals, 1958‡	
	Production	Sales	Production	Sales
Cellulose plastics:[a]				
Cellulose acetate and mixed ester:				
Sheet, under 0.003 gage	18,568	18,030	17,035	16,332
Sheet, 0.003 gage and over	18,448	17,917	18,420	17,743
All other sheets, rods, tubes (including other cellulose plastics)	7,573	7,236	9,071	8,487
Molding, extrusion materials (including other cellulose plastics)	94,193	93,022	90,839	88,428
Nitrocellulose sheets, rods, tubes	3,972	4,114	2,938	3,137
Other cellulose plastics[g]	5,358	4,738	3,056	2,209
Phenolic and other tar-acid resins:				
Molding materials[a]	183,886	177,770	169,161	161,278
Bonding and adhesive resins for:				
Laminating (except plywood)	69,198	46,806	64,445	42,117
Coated and bonded abrasives	16,787	16,555	13,001	11,576
Friction materials (brake linings, clutch facings, etc.)	15,334	13,872	13,473	12,673
Thermal insulation	53,215	52,264	46,971	47,200
Plywood	45,887	36,680	51,411	43,386
All other bonding uses	51,169	48,908	41,367	40,446
Protective coating resins	55,759	49,587	28,736	24,221
Resins for all other uses	40,071	31,004	32,533	27,074
Urea and melamine resins:				
Textile-treating resins	41,160	38,022	34,169	32,184
Paper-treating resins	23,942	23,162	26,181	23,311
Bonding and adhesive resins for				
Plywood	98,115	94,451	99,324	99,741
All other bonding and adhesive uses, including laminating	41,054	33,856	43,395	39,266
Protective-coating resins	36,860	26,846	31,833	25,124
Resins for all other uses, including molding	107,946	105,277	90,510	88,344
Styrene resins:				
Molding materials[a]	422,082	429,066	442,211	449,647
Protective-coating resins	91,641	84,719	95,532	90,607
Resins for all other uses	166,377	139,658	157,761	125,425
Vinyl resins, total[b]	**886,506**	**796,830**	**820,523**	**800,223**
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:				
Film (resin content)		78,029		72,404
Sheeting (resin content)		62,571		67,594
Molding and extrusion (resin content)		218,466		214,701
Textile and paper treating and coating (resin content)		68,446		63,050
Flooring (resin content)		81,248		113,584
Protective coatings (resin content)		31,374		28,921
All other uses (resin content)		94,308		69,094
All other vinyl resins for:				
Adhesives (resin content)		41,965		48,072
All other uses (resin content)		120,423		122,801
Coumarone-indene and petroleum polymer resins	**286,144**	**277,914**	**236,835**	**234,931**
Polyester resins:				
For reinforced plastics	87,466	79,035	98,099	89,021
For all other uses	8,766	6,618	15,764	13,315
Polyethylene resins total:	**707,500**	**662,046**	**865,306**	**836,429**
For film		313,709		317,784
For all other uses		348,337		518,564
Miscellaneous:				
Molding materials[a, d]	52,834	51,559	45,882	45,489
Protective-coating resins[e]	42,730	18,847	18,666	8,214
Resins for all other uses[f]	130,028	120,649	146,913	129,344

*Dry basis designated unless otherwise specified. †Revised. ‡Partially estimated. [a]Includes fillers, plasticizers and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic rosin modifications, nylon silicone, and other plastics and resins for miscellaneous uses. [g]This classification discontinued in May 1958 and this material, mostly ethyl cellulose, reported in sheets and molding material.

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Check these new products and developments for time- and money-saving ideas that you can apply in your own business.

PVC and ABS for Air Force photo lab

Plastics piping and piping components are used almost exclusively in the recently completed photographic development laboratory at Patrick Air Force Base in Florida. Equipment for the facility was supplied by Houston Fearless, Inc., Los Angeles, Calif., and involved over 2½ miles of ⅜- to 2-in. high-impact unplasticized Type II PVC pipe, more than 1450 PVC fittings, 500 Chemtrol PVC ball valves, 150 Kralastic ABS polymer blend pumps, and 55 PVC filters. Pipe, fittings, and filter are produced by Kraloy Plastics Pipe Co. Inc., Los Angeles, Calif.

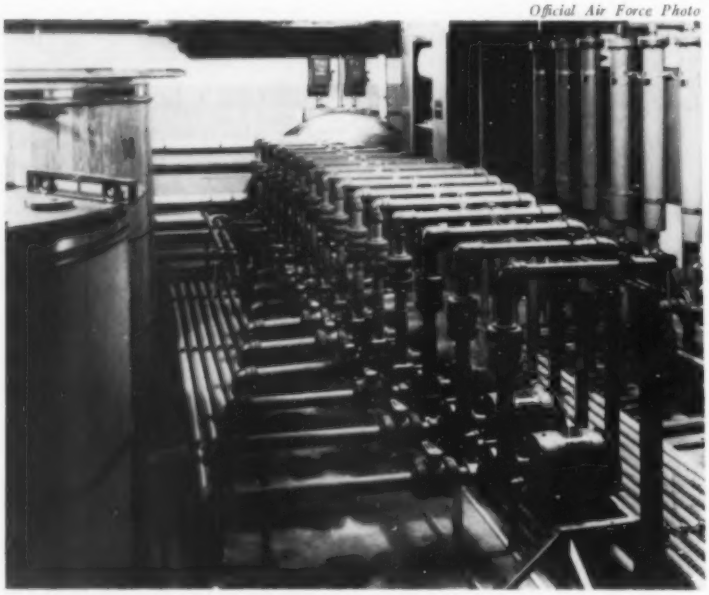
According to E. H. Sturm, project engineer of Houston Fearless, this is the largest installation of its type in the world.

Other plastics uses include 300- and 1000-gal. wooden tanks lined with polyester-glass and 250-gal. vinyl plastisol-coated stainless steel tanks for color developing machines.

Factors involved in the choice of plastics for this installation were primarily the corrosion resistance of the materials. The only nonplastic material compatible with the chemicals in color solution is Hastaloy C stainless, which is quite costly and difficult to machine and handle.

Houston Fearless found that the use of plastics has reduced installation cost and increased the over-all effectiveness of the system without loss in service or efficiency. Plastics also make maintenance easier.

Official Air Force Photo



PORTION OF PHOTO DEVELOPING SYSTEM at Patrick Air Force Base. All pipes, pumps, valves, and filters are of plastics. At left are wooden tanks lined with glass reinforced polyester resin.

Braille checkers

Over 25,000 blind persons have received braille checker games free of charge over the past 18 months.

The checkers are molded of general-purpose polystyrene as part of styrene wall tile production runs. The checkerboard is vacuum formed of high-impact styrene sheet. The checkers are

molded and supplied free of charge by Wilson Plastics, Inc., Sandusky, Ohio; checkerboards are donated by Dow; and Lions International is the distributing agency.

Checker game for the blind consists of round and square checkers and board with indentations. Checkers are indented about 1/16 in. on the top, about 3/16 in. on bottom. Kings are made by turning checkers upside down. The indentations in the formed boards are deep enough so that the checkers will not move out of place when the blind person's hand moves over the board to determine the position of the piece.

Clear castings with new epoxy resin

Suitable for casting, laminating, and bonding, a new water-white transparent epoxy resin has been introduced by Marblette Corp., Long Island City 1, N. Y. Designated Maraglas, the new material is a low viscosity liquid which results in castings that, according to tests reported by the company, have a light *(To page 168)*

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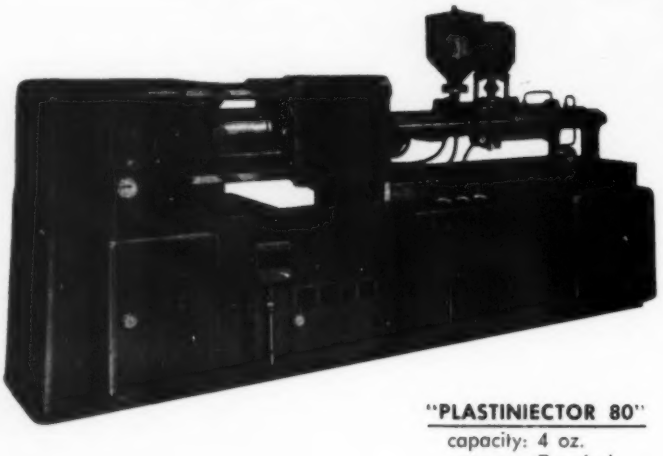

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2 oz.	4 oz.	6 oz.	11 oz.	18 oz.
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Big switch to premium hydraulic oils proves performance repays extra initial cost

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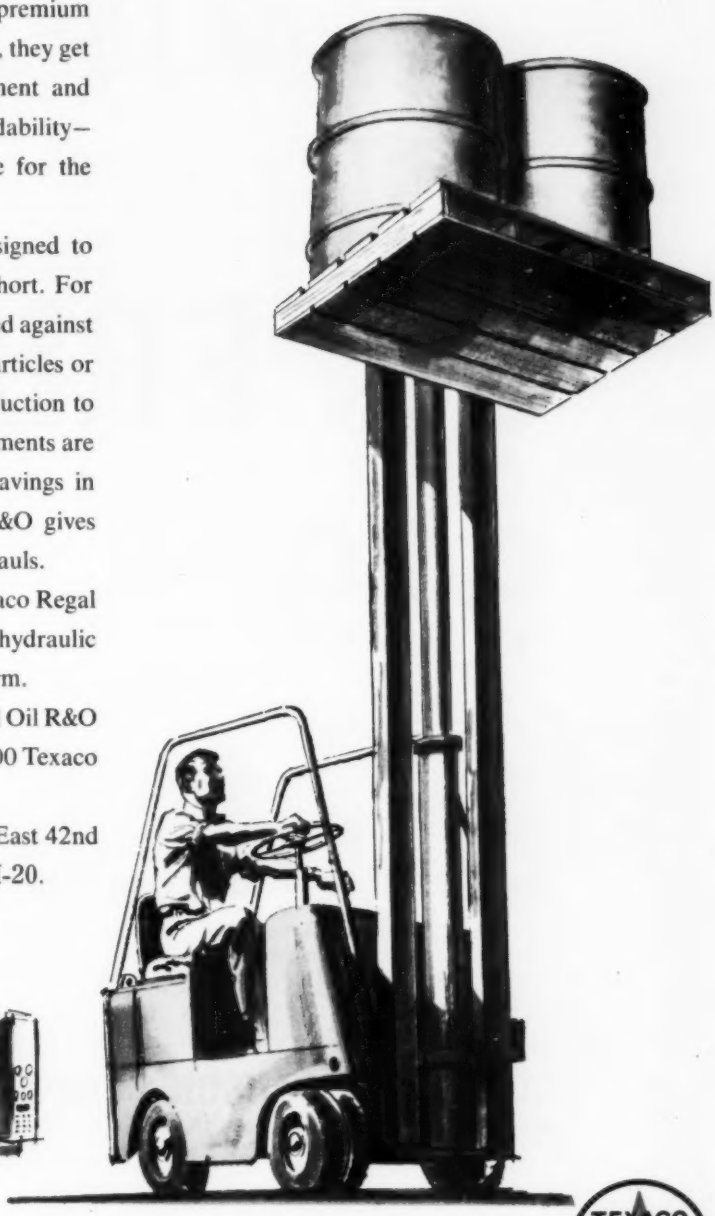
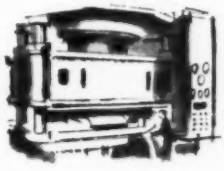
A premium grade hydraulic oil is designed to pick up where straight mineral oils fall short. For example, Texaco Regal Oil R&O is inhibited against rust and oxidation. That means no rust particles or sludge to clog tiny orifices and bring production to a halt. Parts life is extended; fewer replacements are needed. And you can make significant savings in manhours, because Texaco Regal Oil R&O gives longer intervals between scheduled overhauls.

You get fewer rejects, too, because Texaco Regal Oil R&O is fortified against foaming, so hydraulic action stays dependably steady and uniform.

You can get more facts on Texaco Regal Oil R&O by calling the nearest of the more than 2,000 Texaco Distributing plants:

Or, write to The Texas Company, 135 East 42nd Street, New York 17, N. Y., Dept. MP-H-20.





TEXACO

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to provide a complete line of carbon blacks for your most exacting plastics requirements . . . giving you unequalled performance, outstanding end product quality, production efficiency. Typical Columbian carbon blacks for plastics listed below are available in both beaded and powder form.

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. . . excellent blackness and mass tone.

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. . . a good economical carbon black. Get all the facts on Columbian's complete line of carbon blacks. They mean better products and better profits.

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Smoke and smog cannot hide
in any pure Cadet peroxide
For we make them with air
that is apple-blossom rare
In a plant we keep free
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CADET ORGANIC PEROXIDES...

are produced in New York's great apple orchard country . . . in an atmosphere that is not only scrupulously clean but fragrant . . . uncontaminated by industrial wastes. Rigid quality control in the plant assures that you receive dirt free catalysts available for plastics polymerization.

Cadet has specific organic peroxide catalysts for polymerizing vinyl and unsaturated monomers, ethylene, styrene, polyesters, related copolymers, and for curing silicone rubber. These catalysts quickly dissolve in viscous monomers . . . to produce clear, haze-free polymers.

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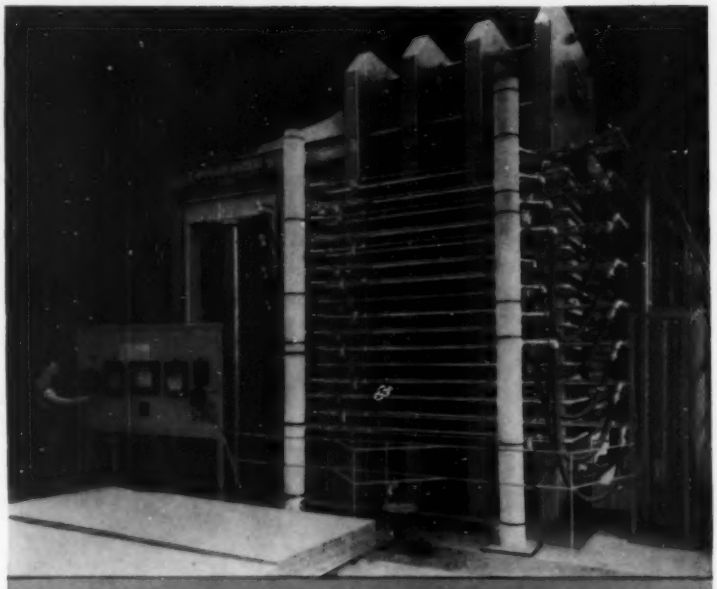

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Platen size 54" x 124"
Fifteen openings
Eight 23" rams
Hydraulic line pressure—3000 #
Platen pressure—1500 psi
With loading and personnel elevators
Weight of press, without elevators—300 tons

SEMI- OR FULLY-AUTOMATIC LOADING AND UNLOADING EQUIPMENT SUPPLIED TO MEET CUSTOMERS' PRESENT OR FUTURE PRODUCTS.

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UNDER SUPERVISION OF ADAMSON UNITED'S COMPETENT ERECTION ENGINEERS, LARGE PRESSES OF THIS TYPE ARE ASSEMBLED IN CUSTOMERS' PLANTS WITH MINIMUM EXPENSE AND DELAY.

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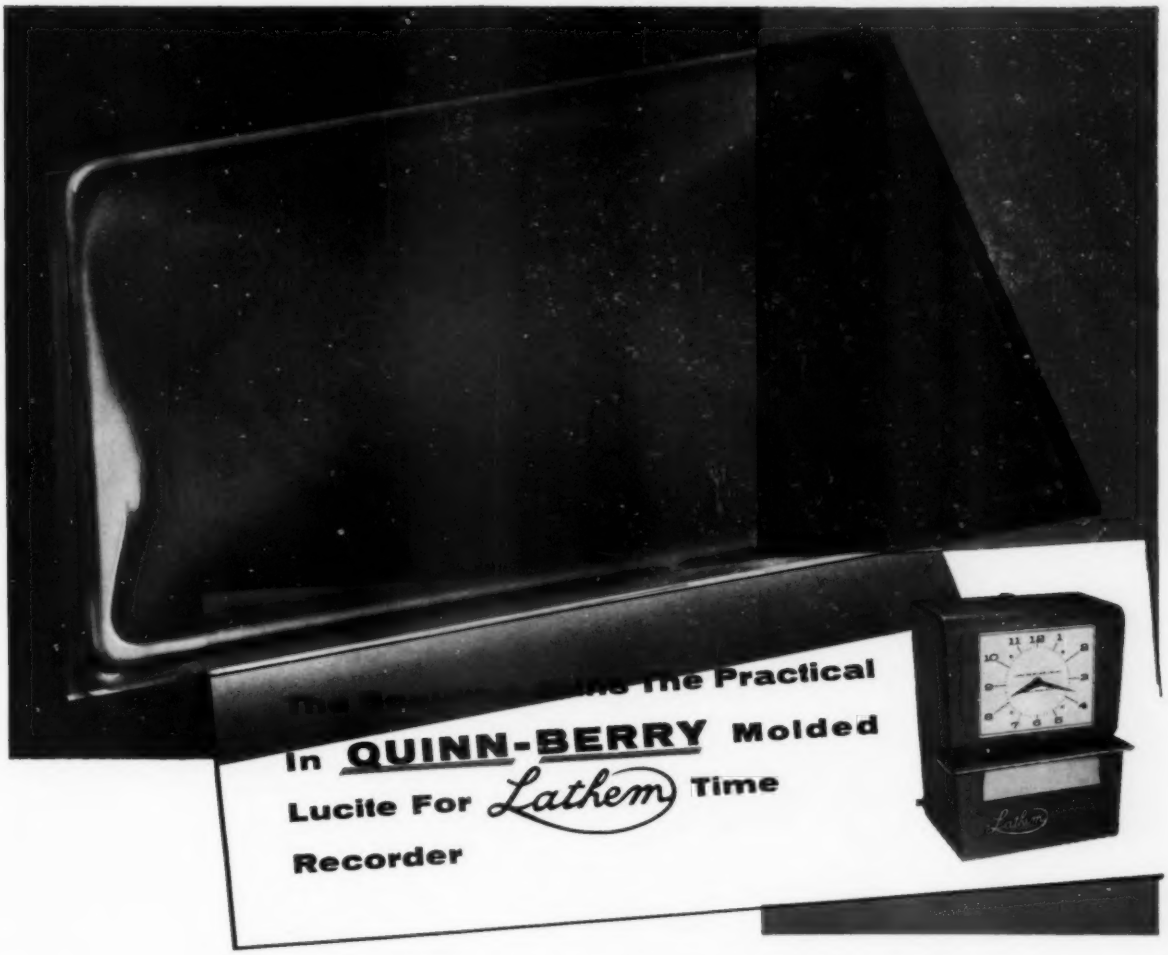

Crystal clear beauty is joined with practical toughness to give greater face visibility to the Lathem Time Recorder . . . DuPont Lucite Crystal molded by Quinn-Berry. Here is what Mr. L. P. Lathem, Jr. says:

"It was the Quinn-Berry Crystal which enabled us to design the new Lathem Time Recorder to give it unprecedented beauty.

"For example, we were able to get a curved Quinn-Berry Crystal which would easily mount in the case of the Lathem Recorder without the need of a bezel. This allowed us to design the recorder so that the face is flush to the clock case, and stands out even more, because of the effect of the curved crystal.

"In addition, this crystal causes no distortion of the face numerals, is unbreakable, resists scratches and discoloration, and does not rattle . . .

"All of us at the factory, as well as our Lathem dealers, have praised the modern appearance of the new Lathem Recorder which owes so much of its design to the qualties of the Quinn-Berry Crystal."

It is quite possible that we can help you with your parts requirements. Consult with us.

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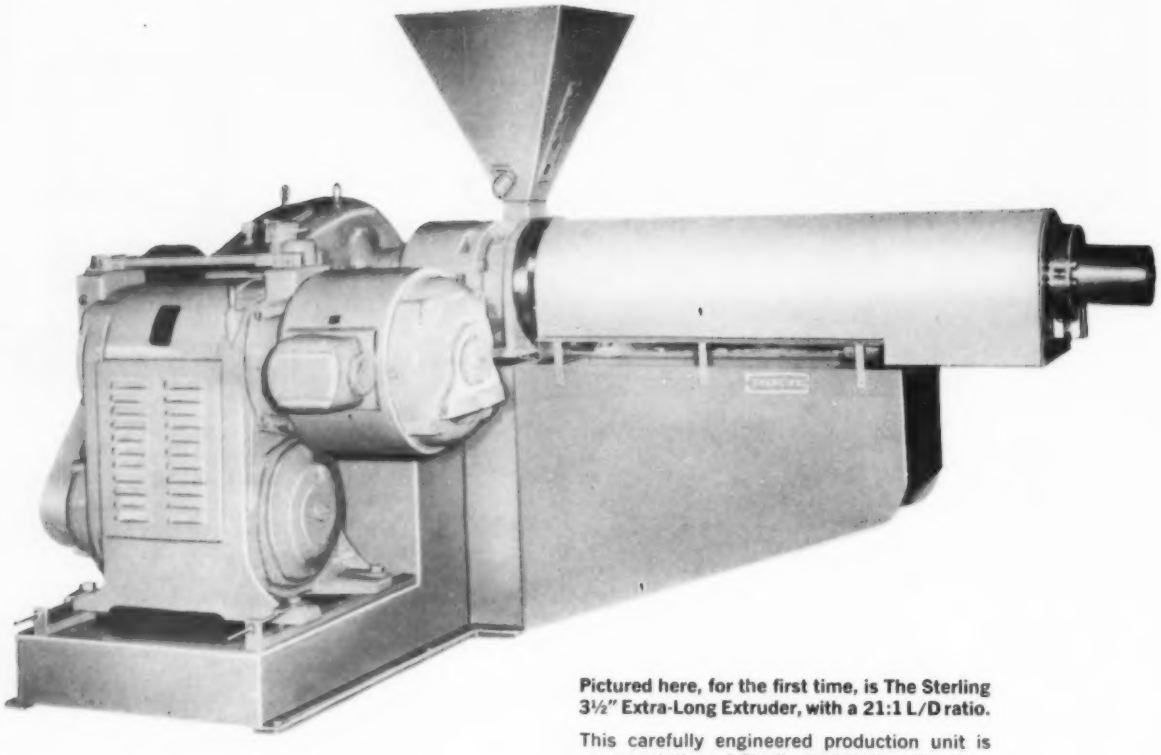
THE NEW STERLING EXTRUDERS



Pictured here, for the first time, is The Sterling 3½" Extra-Long Extruder, with a 21:1 L/D ratio.

This carefully engineered production unit is representative of Sterling's full line, the sizes of which range from 1½" to 6" and whose L/D ratios are 15:1, 21:1, 24:1 and 30:1. Complete packaged units and installations are also available.

Write for complete details to Mr. L. D. Yokana, President, Sterling Extruder Corporation, 1112 Baltimore Ave., Linden, N. J. Telephone: WAbash 5-3908.

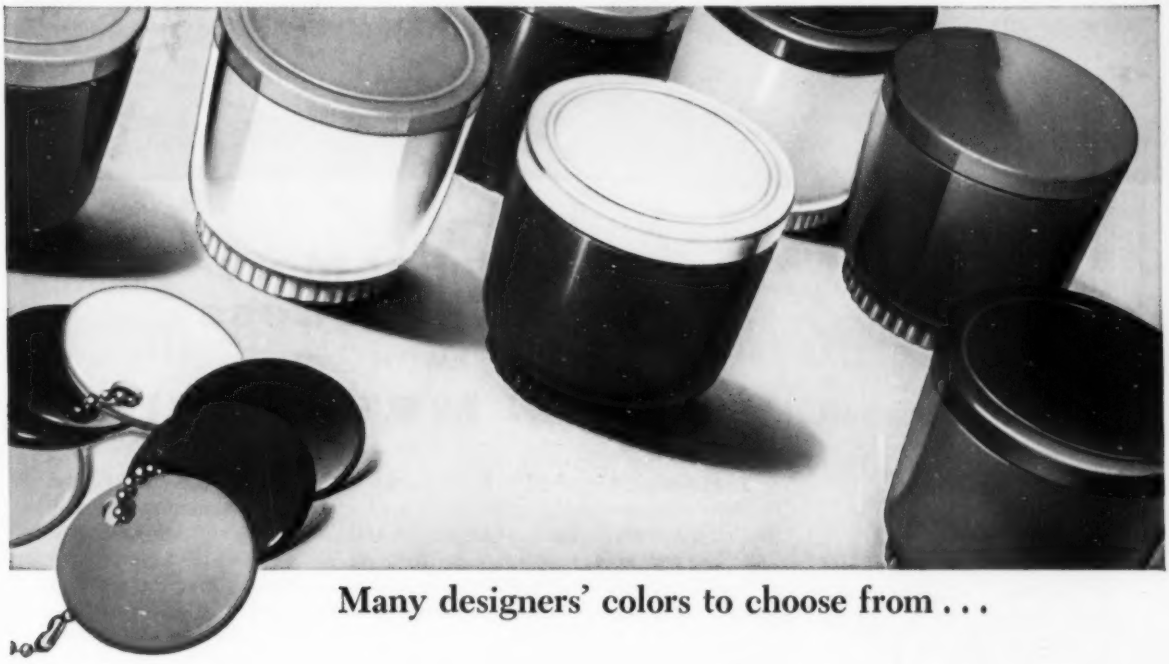
STERLING

STERLING EXTRUDERS

"Designed by plastics men for plastics men"

Convenient screw closure . . .
seals tightly, opens easily

Tip-proof design . . .
jars stack quickly, securely



Many designers' colors to choose from . . .

New Plastic Jar by Owens-Illinois

. . . has all the makings of a top-priced package!

HERE in O-I's new 4½-ounce Plastic Jar you have all the advantages your salespackage needs—color and eye-appeal . . . shelf advantages retailers like . . . user conveniences customers look for. It's a package you'd expect would be priced far higher!

Smartly designed—Plastic Jars stack easily, securely. Their screw closures seal tightly, open easily. And as for color or an eye-catching color combination—you can almost name it! For, in addition to clear plastic, jars are available in a wide variety of opaque and transparent colors. (Also available with domed-top cap.)

* * *

Find out more about O-I's new Plastic Jar. Your Owens-Illinois representative will be glad to show you samples. Telephone him, today!

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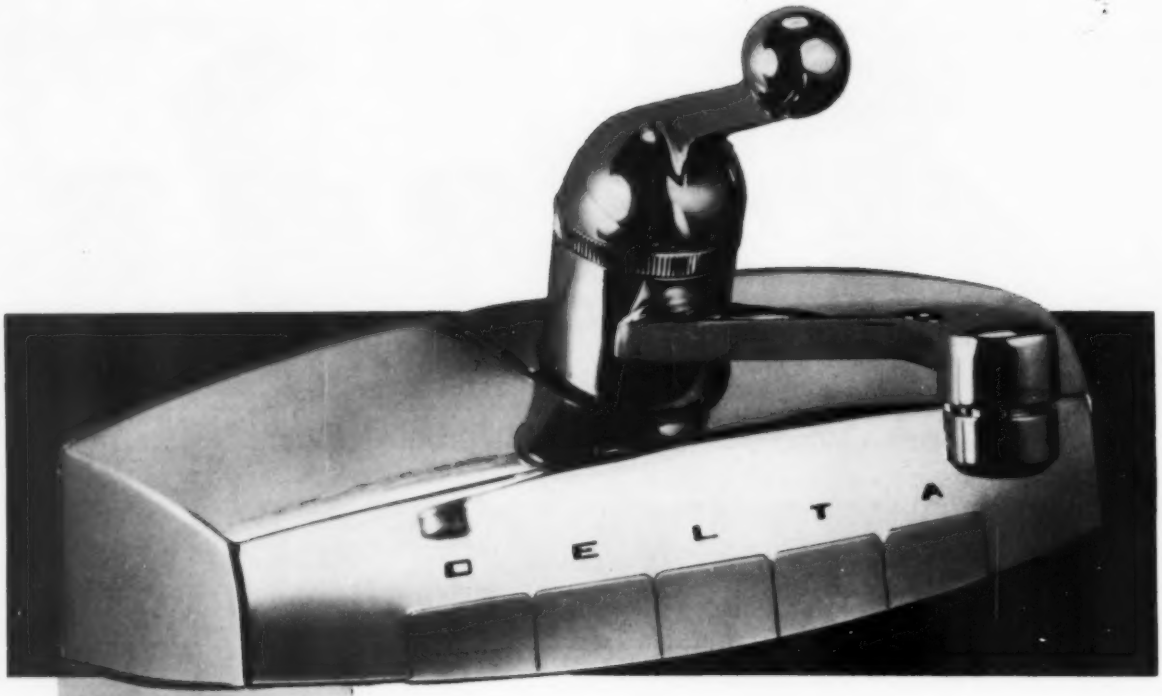
AN (O) PRODUCT

OWENS-ILLINOIS
GENERAL OFFICES · TOLEDO 1, OHIO



More than 150,000 square inches per hour can be metallized in this NRC "Rapid Vacuum Coater". Tank sizes range from 12" diameter by 13" high for laboratory use to 66" diameter by 60" long for high volume production.

Sell It For More Make It For Less

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VACUUM METALLIZING

Even though it is priced at $1.00 more, a vacuum metallized desk novelty outsells a painted model of the same product 10 to 1. Vacuum metallizing helped a reflector manufacturer cut his total cost 65% and his customers liked the new product better.

Vacuum metallizing can give almost any product a gleaming metallic finish in any one of a variety of rich, exciting colors. It hides surface blemishes and permits the use of lower cost base materials. Metallizing costs can run as low as 1/5¢ per square inch.

Clear plastic parts are often metallized on the reverse side to give the appearance of a brilliant metallic piece cast in the plastic. Intricate, multi-colored designs can be economically produced.

You owe it to yourself to get in touch with your nearest NRC engineer. Without obligation, he will evaluate your application, supply metallized samples of your product and estimate your processing cost.

If requirements make it profitable for you to buy your own NRC equipment our engineers are ready to lay out your facility, supply all equipment, supervise its installation and train your operators. If your volume doesn't justify equipment of your own, we'll recommend sources for having your particular kind of work done. Write or phone us today.

NRC

NRC

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Introduces New Controls in an Inexpensive Liquid Stabilizer

For the first time

performance variations due to resin or plasticizer or filler are minimized...

For the first time

storage problems due to exposure of stabilizer or compound to oxidation or moisture are eliminated... with STABILIZER 6-V-2

The Harshaw Chemical Company

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VINYL STABILIZER 6-V-2

Highest mileage in heat and light stabilization plus the new regulating effects are yours at no extra cost

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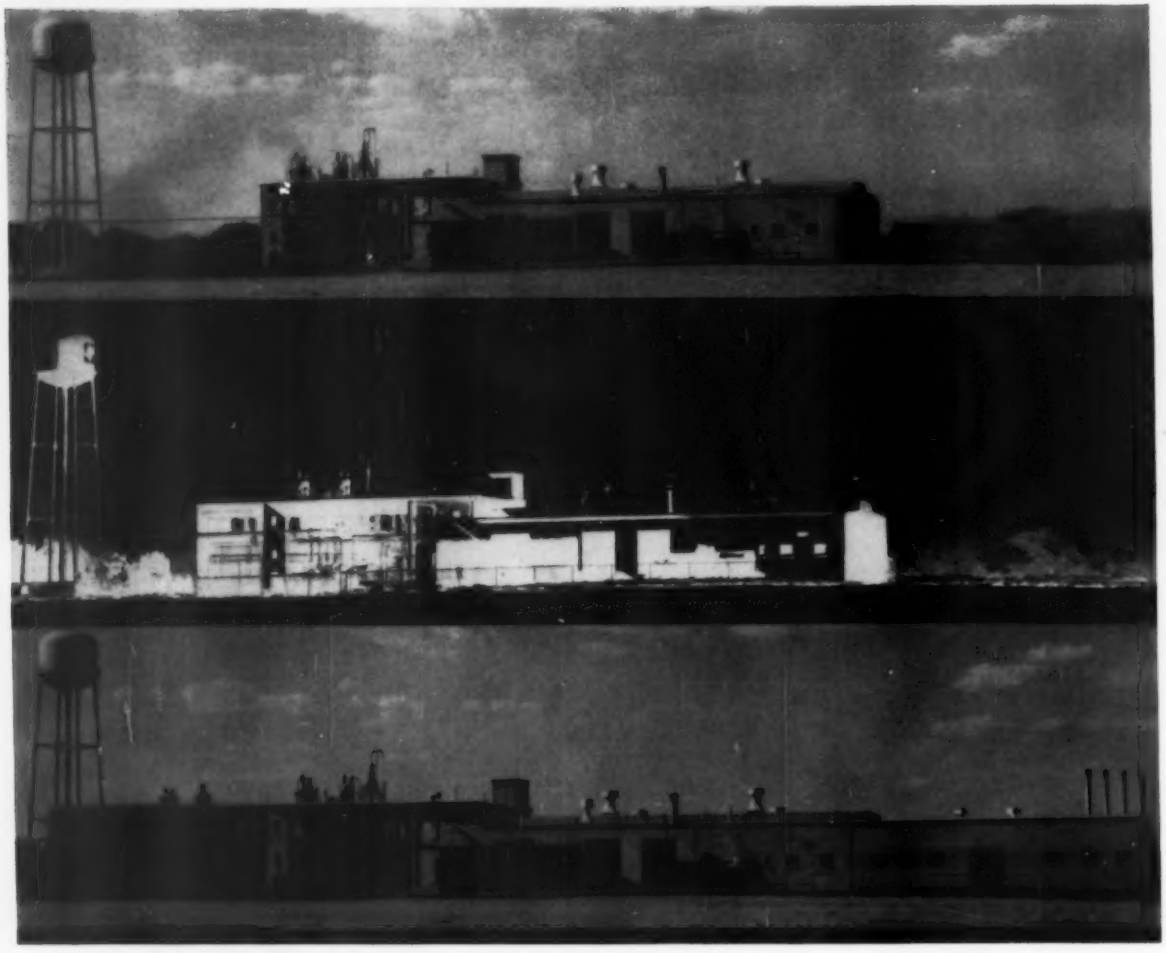
Blaw-Knox built them all—starting with National Starch's original plant, and continuing with the design and construction of two successive expansions. Responsibility included all buildings, process equipment and utilities.



at Meredosia, Illinois

National Starch increases polyvinyl acetate production 200% in three years

In 1955 a new plant . . . by spring of '56 an expansion that doubled capacity . . . today a second expansion that will again double original capacity.

In all of this dynamic growth National Starch and Blaw-Knox have been building together. From the first, owner and contractor formed a smooth working team as they erected the original plant. This same team was put to work again and again as National Starch retained Blaw-Knox to design and build two plant expansions.

It is the winning combination of men solving problem after problem that has kept all the projects moving ahead on schedule.

To learn how Blaw-Knox's broad experience and technical resources can help you with a process, a new facility, or plant modernization or expansion, contact Blaw-Knox Company with headquarters in Pittsburgh, branch offices in New York, Chicago, Haddon Heights, New Jersey, Birmingham, Washington, D.C. and San Francisco.

plant builders for industry . . . BLAW-KNOX

Give Your Product Permanent New Beauty...Dazzling Sales Appeal...with the Magic of

PLASTICS MOLDED BY J.P.GITS

"CRYSTAL SEAL" PROCESS. A beautiful, 3-dimensional effect achieved through injection molding, spray painting and vacuum metalizing, with colored letters and decoration permanently embedded within crystal-clear plastic.

Here is one of the most beautiful products ever created in plastic . . . the new Citation Dispenser for Coca-Cola—manufactured by The Dole Valve Company, Morton Grove, Illinois. Designed by The Coca-Cola Company, Atlanta, Georgia. Cabinet housing injection molded, finished and assembled by J. P. GITS Molding Corporation for The Dole Valve Company. It is a brilliant example of the patented J. P. GITS "Crystal Seal" and "Multi-Shot" processes.

Picture YOUR product advertised this way—displaying your trademarks, medallions, nameplates; your point-of-sale signs, dials, toys, cabinets, or you-name-it. Nothing else can give them so much vitality, vivid beauty and sales appeal. Nothing provides such a competitive "plus."

Want to know how "Crystal Seal" and "Multi-Shot" can help you? Write for details. Or contact your nearest J. P. GITS representative.

"MULTI-SHOT" PROCESS. A single, finished 3-dimensional panel combining two or more colors by *permanently* embedding one piece of injection molded plastic into another. Permits intricate designs and shapes that are impervious to weather, wear or wiping.

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Physical Properties of Polyester Laminate

	28.5% Surfex MM	40% Surfex MM	50% Surfex MM	60% Surfex MM
Specific Gravity	1.76	1.80	1.87	1.95
Izod Impact, Ft. Lbs./In. Notch	14.4	16.2	17.3	16.5
Tensile Strength, psi	20,300	21,300	20,100	19,300
% Elongation	1.89	1.24	2.03	1.87
Modulus of Elasticity in Tension, psi x 10°	1.15	1.36	1.45	1.85
Flexural Strength, psi	33,150	33,600	37,800	37,000
Modulus of Elasticity in Flexure, psi x 10°	1.08	1.18	1.44	1.20
Barcol Hardness (10 sec. Reading)	55	57	62	66
Initial Viscosity of Mix	1,200	2,100	3,200	5,000
Fiber Glass Mat	40%	40%	33%	33%

New data for Polyester Laminates shows costs down, flexural and impact strength up... with Diamond SURFEX MM®

Here's the extender you've been looking for. In addition to improving flexural and impact strength—while still keeping costs low—high loadings of this amazing precipitated calcium carbonate provide *all* the top properties *you* want in *your* laminate.

Increased hardness . . . less shrinkage . . . greater modulus of elasticity in tension and flexure. Better surface finish . . . improved wet strength . . . and a more even cooling rate.

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ABSOLUTE RELIABILITY

INCREASED PRODUCTION

MINIMUM MAINTENANCE

HIGH QUALITY FINISH

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All over the World manufacturers have long recognised the superiority of Windsor Injection Moulding Machines. Faster moulding cycles, maintenance of high quality products over long production runs, and continuous trouble-free operation have put them in the forefront of the Plastics Machinery Industry. Up-to-the-minute in design and precision built throughout, the Windsor range includes Injection Moulding Machines from 1 oz to 210 ozs capacity and Extrusion Machines of double and single screw types with outputs up to 450 lb per hour.

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WINDSOR—THE PLANT BEHIND THE PRODUCT

HERE'S THE STORY ABOUT **Moplen*** POLYPROPYLENE: Now in commercial production, "MOPLEN" is first member of a new class of unique thermoplastic materials... Isotactic polymer possesses superior characteristics.

PROCESSING OF "MOPLEN"

EXTRUSION — Extrusion is easily carried out by means of the conventional equipment employed for polyethylene (screw having 4:1 compression ratio and length equal to 18-20 times its diameter). As with polyethylene, care should be taken to follow the normal working methods to obtain good performance of the cooling and draw-down systems.

Wire covering — In covering wire, "MOPLEN" exhibits excellent electrical and mechanical properties, as well as high resistance to environmental cracking. The wire-covering process is not difficult, but care should be taken to cool slowly in blown air or, for some distance, in room temperature air and finally in water.

Pipes — Temperatures generally employed for pipe extrusion are:

190°—210°C (374—410°F)

Cool quickly with water as pipe emerges from the sizing die.

Sheeting — "MOPLEN" can be extruded in sheets of any thickness and color.

Films — Films can be obtained both by blowing and flat die processes. Approximate temperatures:

	flat die	blowing
Barrel	180°C (356°F)	170°C (338°F)
Nozzle	220°C (428°F)	200°C (392°F)

If fast cooling in water is employed, the gloss and transparency of flat die films are much superior to those shown by polyethylene and polypropylene blown and unquenched film. Rather slow cooling should be used for blown film.

Heat Sealing — "MOPLEN" film may be heat-sealed with the same equipment used for the welding of polyethylene film. Owing to "MOPLEN's" very low dissipation factor, high-frequency equipment should *not* be used.

Paper, cloth and aluminum coating — Use a flat die and lay the hot film immediately on the substrate (paper, cloth or aluminum sheet) using two rollers, one of rubber, the other of steel.

Filaments — Conventional methods (extrusion and hot drawing) can also be used with "MOPLEN." After drawing, the tensile strength of the filaments may equal that of the best monofilament obtained with other plastics.

Blown containers — Containers are made by the same method used for blowing polyethylene.

Temperatures

Barrel	175° to 185°C (347°—365°F)
Nozzle	210° to 230°C (410°—446°F)

Air injection — The air need not be heated, but the pressure should be increased progressively.

Note. In order to avoid the effects of prolonged heat above 200°C (392°F), the following working instructions should always be observed:

During both the extrusion and the injection molding, never exceed a given temperature limit. This varies, depending on the particular equipment and the speed of extrusion, but is usually of the order of about 270°C (518°F). Temperature of barrel should increase progressively from the hopper to the head. At the head, the temperature should be slightly reduced. In some cases, such as with large straight head extruders for film, it may be necessary to increase the temperature of the head somewhat.

For more detailed information about "MOPLEN," please write, outlining area of interest, to

Chemore Corporation
General Representative in U.S.A. and Canada for Montecatini
21 West St., New York 6, N. Y.

Foil and films made from Montecatini's new "MOPLEN" polypropylenes are unusually clear, chemically inert, water resistant, and possess good temperature properties. Permeability to gases is lower than polyethylene, and they are impermeable to water vapor. "MOPLEN" films can be printed with known techniques.

*Montecatini Trademark

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U. S. Representatives: CHEMORE CORPORATION • 21 WEST STREET, NEW YORK 6, N. Y. HANOVER 2-5275

Now! New eye appeal for polyethylene containers with...

NEW IC *Plethcote*® VARNISH

Adds Brilliant "Buy Appeal" to Poly Containers

Now! A crystal-clear overprint coating brings sales zing to poly containers! IC PLETHCOTE makes them light-up with glossy "buy-appeal" . . . brings out rich, glittering colors of inks . . . guards print from damage by abrasion or by spillage of contents.

Unlike many overprint varnishes, it imparts no color either when freshly applied or after extended exposure to strong light.

Formulations can be applied by roller coating or spray; some over either wet or dry ink. All provide completely compatible decorative systems with I.P.I. inks.

IC PLETHCOTE air dries in about 5 minutes at room temperature. But for maximum performance low-density poly should be baked at 150°F. for 15 minutes; high-density poly at 225°F. for 5 minutes.

Pep up your poly containers! Write for details today!

Interchemical
CORPORATION
Finishes Division

Headquarters Office: 224 McWhorter St., Newark 5, N.J. Factories: Chicago, Ill. • Cincinnati, Ohio • Elizabeth, N.J. • Los Angeles, Cal. • Newark, N.J. • Mexico City, Mex. In Canada, this product is made by Aulcraft Paints, Limited, Toronto, Ontario, and sold under its trademark. **IC and Plethcote are trademarks of Interchemical Corporation.*

SYMPHONY OR SWING RECORDS ARE BEST WITH
WITCO-CONTINENTAL CARBON BLACKS

For top performance, from record press to player, specify Witco-Continental Carbon Blacks. The high electrical conductivity of Witcoblaks® HAF and ISAF eliminates annoying static... lower needle noise increases listening enjoyment. For your next batch, be sure to specify Witco.

There's a Witco-Continental Carbon Black exactly right for *every* plastics application. Write today for technical details of Witcoblaks suitable for your plastic products.

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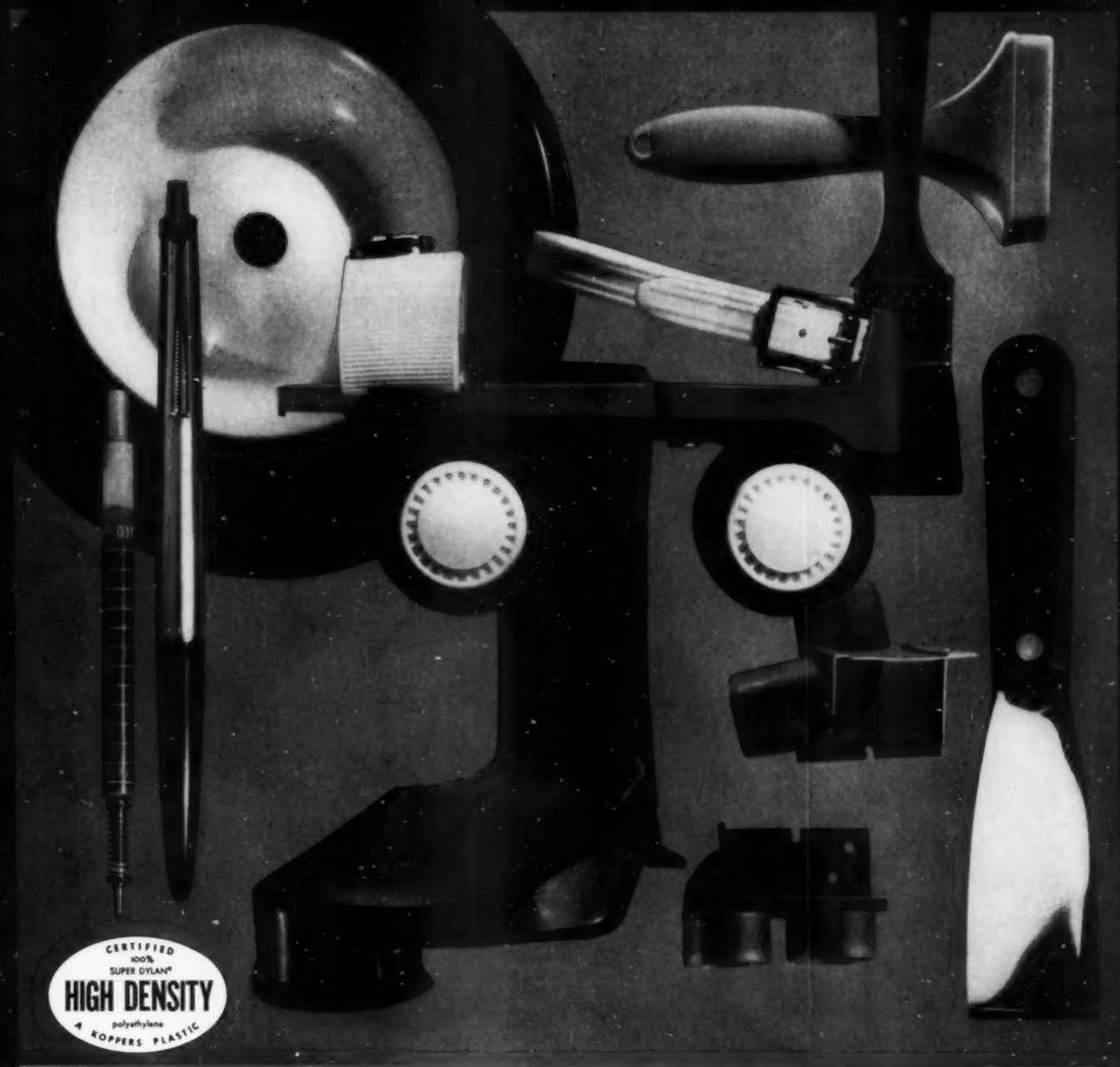


SUPER DYLAN polyethylene gets to the heart of tough design problems

Light-duty wheels—where a tough, rust-proof, light-weight, easily moldable material is needed—SUPER DYLAN.

Putty knife and paint brush handles—where a low cost, durable material, to which paint will not stick, is called for—SUPER DYLAN.

Auto heater and defroster outlet—where a material must remain dimensionally stable under heat without losing its strength or rigidity—SUPER DYLAN.

Scripto Pen cartridges—where outstanding environmental crack-resistance is a must; clear enough to see the ink supply—SUPER DYLAN.

Roller skates—where a moldable, colorful material with built-in self-lubricating properties to combat friction is called for—SUPER DYLAN.

If you're designing a product that demands a hard-working, chemically-resistant plastic that is strong, easily colored, possesses a glossy finish and is simply processed—SUPER DYLAN is your answer. For more information, write to Koppers Company, Inc., Plastics Division, Dept. MP-49, Pittsburgh 19, Pa.

DYLITE *expandable polystyrene*, DYLENE *polystyrene and* DYLAN *polyethylene are other fine plastics produced by Koppers Company.*

Offices in Principal Cities · In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario

KOPPERS PLASTICS

DYLITE, DYLENE, SUPER DYLAN and DYLAN are registered trademarks

KOPPERS

Relative Ratings of Low-Temperature Vinyl Plasticizers

(10 best, 0 poorest)

	Dioctyl Isosebacates	Diisooctyl Isosebacate	Octyl Sebacates	Octyl Azelates	Octyl Adipates	Diisodecyl Adipate	Dioctyl Phthalate (blending material)
Compatibility (roll spew)	6	5	6	7	9	5	10
Strength: tensile, modulus, elongation	7	6	7.5	7.5	8	7.5	9
Low Temp.: stiffness, brittle point	7.5	7.5	8.5	8.5	8.5	7.5	3.5
Stability: heat and light	8	8	7	8.5	7	6.5	8
Extraction: water, soap soln.	8.5	8.5	9.5	7.5	4.5	6	8
Extraction: oil (vegetable, mineral)	3.0	4	2	1	1	3	7
Volatility (carbon)	7	7	8	6.5	2.5	7	7
Relative Rating	47	46	48.5	46.5	40.5	42.5	52.5
Approximate Price Index* (Isosebacates = 100)	100	100	135	105	90	90	65

Based on current (Aug. 1958) prevailing prices for finished plasticizers

Esters of ISOSEBACIC® Acid Compare Favorably with Other Vinyl Plasticizers

Octyl esters of the new U.S.I. ISOSEBACIC Acid have been evaluated against accepted vinyl plasticizers in a complete series of tests at the U.S.I. laboratories. The performance results, expressed as relative ratings above, have been coupled with current price indexes to show comparisons which are meaningful to the maker of vinyl plasticizers. Here are the conclusions:

The octyl isosebacates are less expensive than sebacates and closely competitive in overall performance. They have an edge over azelates on cost and are about equal in performance. While comparing closely on cost with the adipates, they are better on overall performance. On specific properties, such as heat stability and resistance to extraction by vegetable and mineral oils, the octyl isosebacates are superior to other low-temperature vinyl plasticizers.

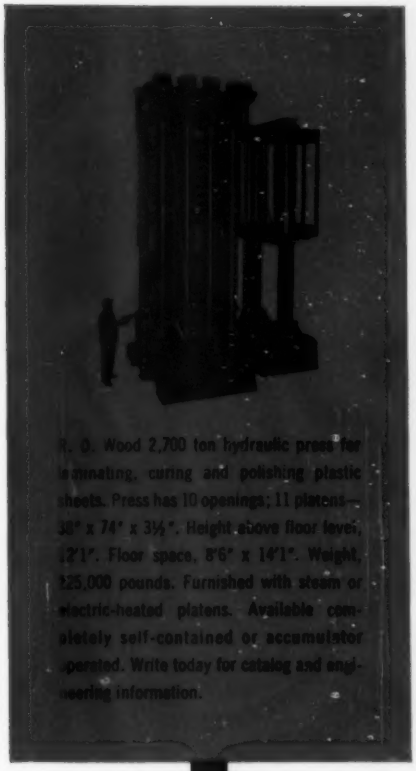
ISOSEBACIC Acid is a new synthetic intermediate made by U.S.I. — a mixture of the three C-10 dibasic acids: 2-ethyl suberic, 2,5-diethyl adipic and sebacic acids. It is not subject to the price fluctuations unavoidable with raw materials derived from natural products.

This valuable new intermediate will be available soon in commercial quantities from a new U.S.I. plant at Tuscola, Ill. Now is a good time to evaluate ISOSEBACIC Acid as a raw material for your operation. Send for pilot plant samples and technical data bulletins.

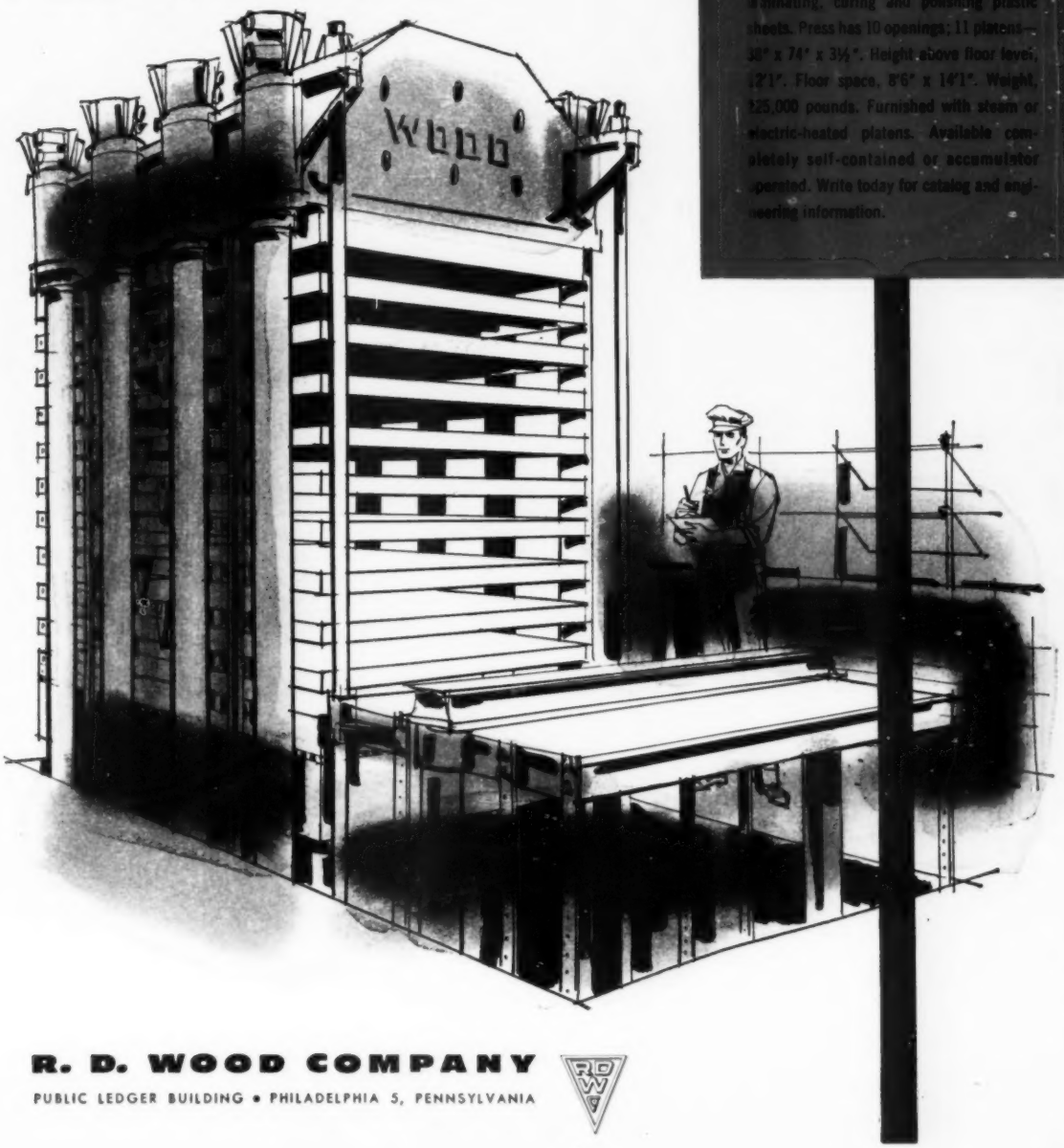
U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

R. D. Wood Plastic Laminating Press produces superior sheets with minimum "idle" time

Plastic sheets with superior surface finish, uniform thickness and exceptional strength characteristics result every time you laminate, cure or polish with a Wood Press. So regularly, in fact, that you take superior performance for granted. But here's a Wood that gives you an added bonus—savings in time! While the press is closed, curing ten-sheet packages, ten additional packages can be prepared for processing and inserted in alternate openings of the 20-opening elevator. Dual operation speeds loading and unloading . . . keeps press in constant operation. No down time. No lost motion. A natural for every plastics manufacturer.



R. D. Wood 2,700 ton hydraulic press for laminating, curing and polishing plastic sheets. Press has 10 openings; 11 platens—38" x 74" x 3½". Height above floor level, 12'1". Floor space, 8'6" x 14'1". Weight, 125,000 pounds. Furnished with steam or electric-heated platens. Available completely self-contained or accumulator operated. Write today for catalog and engineering information.



R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA

The diameter of asbestos fibre in inches ranges from 7.06×10^{-7} to 11.8×10^{-7}. Shown above is not just one but a number of strands.

The **fineness** of J-M Asbestos Fibre assures higher loading, greater strength for your plastics

THE BROAD COVERAGE and dispersability of Johns-Manville Asbestos Fibre . . . plus its exceptionally high tensile strength . . . can add competitive advantages when used as a plastics reinforcer for products ranging from floor tile to molded electrical parts.

Compare the coverage of this J-M "magic mineral" with glass fibre: only 4,000 glass fibres to one linear inch . . . as many as 1,000,000 asbestos fibres in the same space!

Compare its amazing strength with ingot or wrought iron: greater than an equal thickness of either one!

In addition to these two outstanding properties, you will find J-M Asbestos Fibre, because it is of the Chrysotile variety, provides the best combination of properties offered by any filler on the market. It bulks, reinforces, controls impact strength, improves dimensional stability. In addition, you can depend on J-M Asbestos Fibre to reduce molding costs whether you work with thermoplastic, thermosetting, or cold-molded plastics.

If you would like more information on how you can improve plastics with the J-M "magic mineral," write for your free copy of brochure AFD-8A. Address: Johns-Manville, Asbestos Fibre Division, Box 1500, Asbestos, Quebec, Canada.

Characteristics of J-M Chrysotile Asbestos used in the Plastics Industry:

Type of Asbestos: Chrysotile
Specific Gravity: 2.4—2.6
Color: Dry: Light gray—Wet: Dark gray

Approximate Chemical Analysis:

MgO	40-42	FeO	Tr-6
SiO_2	38-42	Fe_2O_3	Tr-6
H_2O	12-15	Al_2O_3	Tr-3

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

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NEW HELIOGEN® VIRIDINE Y

Heliogen Viridine Y marks the first major expansion of the phthalocyanine spectrum since its introduction. This is the yellowest green pigment available for producing vivid, lightfast, non-dichromatic shades in all depths in plastics, inks, paints and textile printing.

Heliogen Viridine Y has very high tinctorial strength and is stable to organic solvents, acids and alkalis. It is additionally versatile because of the many forms available to fit your needs: toners, lakes, dispersed powders, water dispersions, pastes, presscakes.

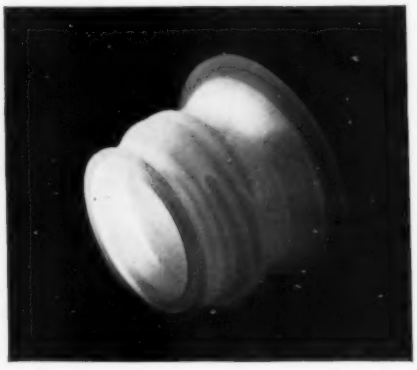
Be among the first to use this exciting new color. Write direct or call your GDC representative for information and samples.

Printed with New Heliogen Viridine Y

Printed with Heliogen Green [illegible]

This silver-plated decorative bowl base is made of polystyrene plastic. With high polish the chief requirement, Lustre-Die tool steel was used in the die.

Here's an interesting use for Lustre-Die—molding plastic heels for women's shoes. Lustre-Die was selected because of its good machining characteristics, plus its ability to take an unusually high polish.



This product, which is both good looking and durable, is a plastic section for the top of a detergent can. It was formed by a die of Lustre-Die.

For that extra-special sheen . . . use LUSTRE-DIE

Need a plastic surface which is unusually smooth and sparkling?—one that's almost mirror-like in sheen? Then Lustre-Die is the right tool steel.

Lustre-Die gives a high sheen to molded products because it takes an unusually bright polish. Lustre-Die has a basic analysis which is specially intended for plastic molding. And to further improve its fine properties, we add a special alloy fortification. We furnish it oil-quenched and tempered, ready for machining and polishing.

Melted under close control in the electric furnace, Lustre-Die is carefully inspected to insure absolute cleanliness. It's free from porosity. Free from surface pitting. And it's engineered for economical molding.

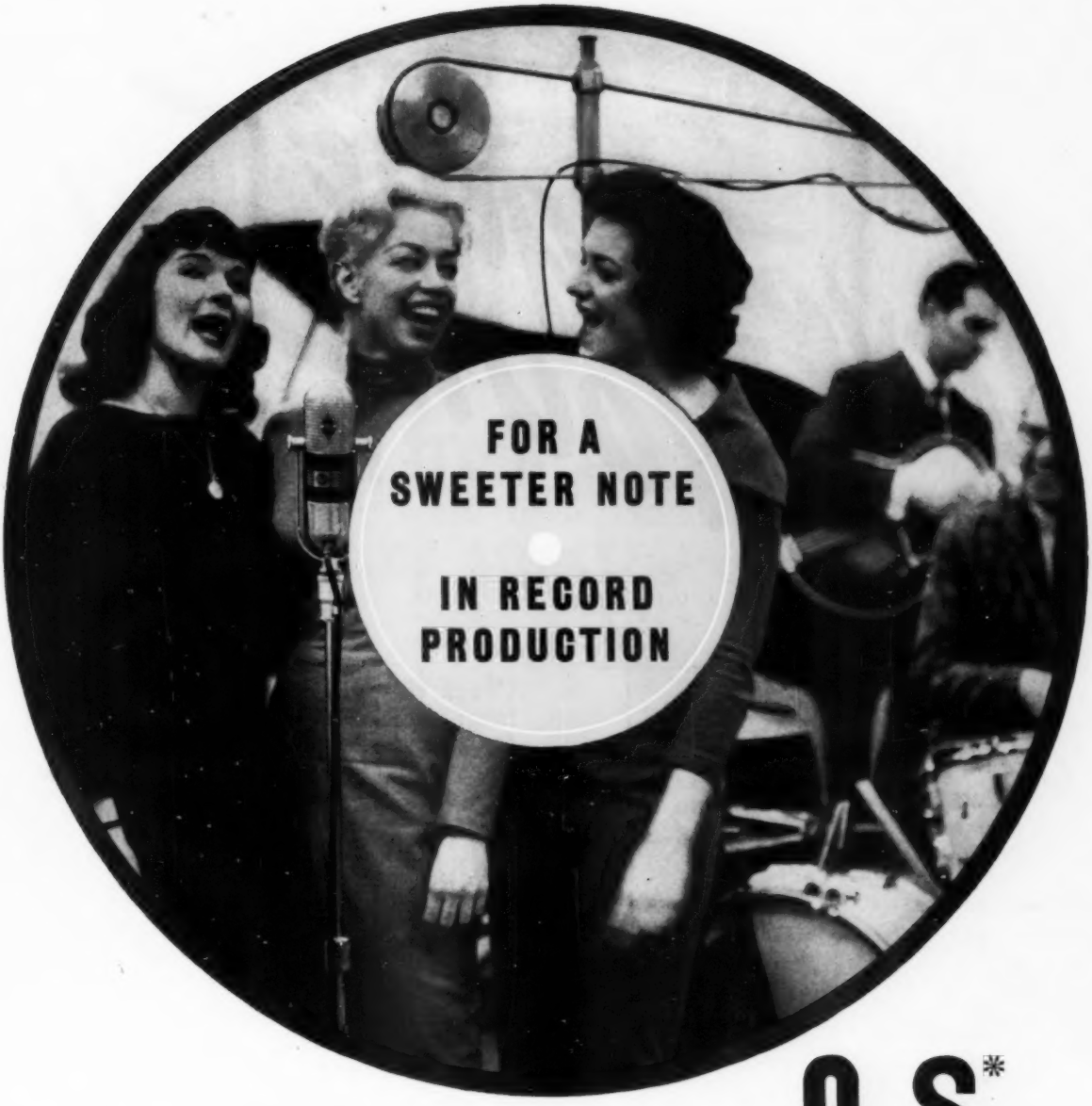
Put Lustre-Die to work, for top performance in plastic molding. Your Bethlehem tool steel distributor can supply you promptly.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



USE BORDEN COPOLYMERS WITH O.S.*

PRODUCTION HUMS when your copolymers are truly uniform—bag after bag, month after month. You get that kind of *OPERATIONAL STABILITY—O.S.—from *every* bag of *any* Borden copolymer resin . . . every batch the same . . . every batch specification tested . . . every batch up to Borden's high standards of quality.

YOUR GAIN: Operational stability in *your* production that means lower costs and top quality in *your* product.

EXAMPLE: Discs pressed from Borden's VC-113 and VC-161 have high flexural strength, good heat and abrasion resistance, and no noise, even after repeated playings. And they cost less to make.

HERE'S WHY: Both VC-113 and VC-161 have high bulking densities and rapid fusion rates. That means more pounds of resin per mill charge and shorter mixing cycles. There's no dusting problem and less storage space is required. Balanced flow properties cut "non-fills". Heat stability minimizes blisters and porosity. And all commonly used pigments, extenders and stabilizers are compatible with VC-113 and VC-161.

GET THE FACTS: Whether you press records, produce vinyl-asbestos flooring, or process vinyl solvent solutions, the OPERATIONAL STABILITY of Borden copolymers can help you cut costs and improve product quality. Get the facts from The Borden Company, Polyvinyl Chloride Dept. MP-4, 60 Elm Hill Ave., Leominster, Mass.

IF IT'S A Borden Chemical IT'S GOT TO BE GOOD!

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COMPARE!

In High-Density, 17 "BAKELITE" Polyethylene Compounds for New Products and Profits Like These

Check the unique, *low-to-high* density range of BAKELITE Brand Polyethylenes for your *widest selection of properties*—whatever your end-use application. Your choice covers densities from .916 up to .960—a spectrum *unequalled in the field* to let you match properties exactly to your purpose.

With "BAKELITE" *high-density* materials, properties include a range of melt

EXTRUSION COATINGS

Multi-trip bottled beverage cases

Multiwall bags and barrier papers

EXTRUSIONS

Wire and cable

Monofilaments for furniture tape

Monofilaments for rope and twine

Contour extrusions

INJECTION & BLOW MOLDING

Bottles and packaging

Housewares

Large cases and housings

Here are some of the several-score products successfully manufactured from the new "BAKELITE" Brand high-density polyethylene compounds. If there's a profit idea here for you, call your Technical Representative.

1143

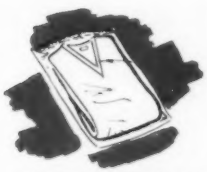
HIGH

Polyethylene from the source widest density spectrum!

indexes in combination with particular qualities for molding, extrusion, coatings and film applications. High flow rates—higher rigidity — heat resistance — grease and moisture impermeability — toughness —gloss—abrasion resistance and other properties are provided "as you want them." Check your Union Carbide Technical Representative—and, for the leaflet which lists all "BAKELITE" Brand High-Density Polyethylenes write Dept. DC143.

TO

FILM



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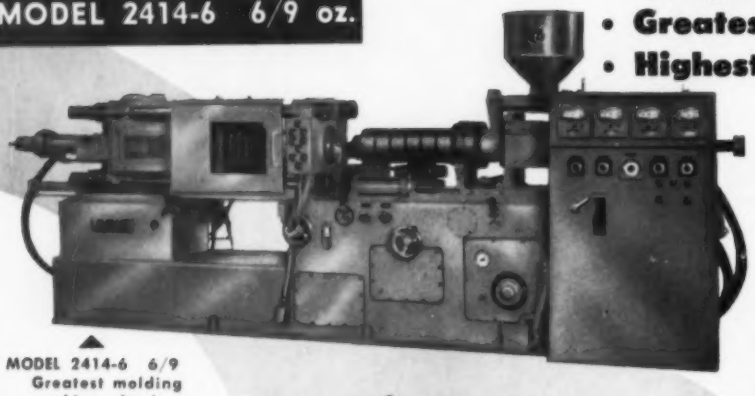
LOMBARD
Injection Molders

- **Complete Versatility**
- **Greatest Locking Pressure**
- **Highest Speeds**

MODEL 2414-6 6/9 oz.

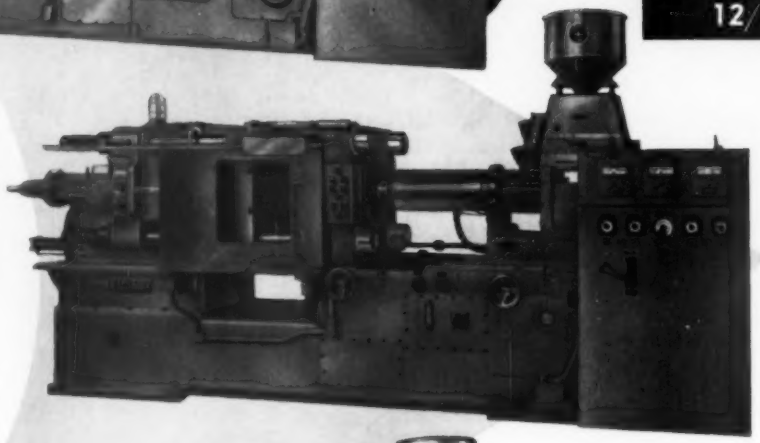


MODEL 2414-6 6/9
Greatest molding machine development in years.

MODEL 3214-12 12/16
Die space (720 square inches), more daylight opening (42") and more plasticizing capacity (150 lbs. per hour) than any other 12 oz. press.

MODEL 3220-16 16/20
Compare these features — 420 dry cycles per hour, 20" toggle clamping stroke with 42" of daylight opening and plasticizing capacity of 200 lbs. per hour.

MODEL 3214-12
12/16 oz.



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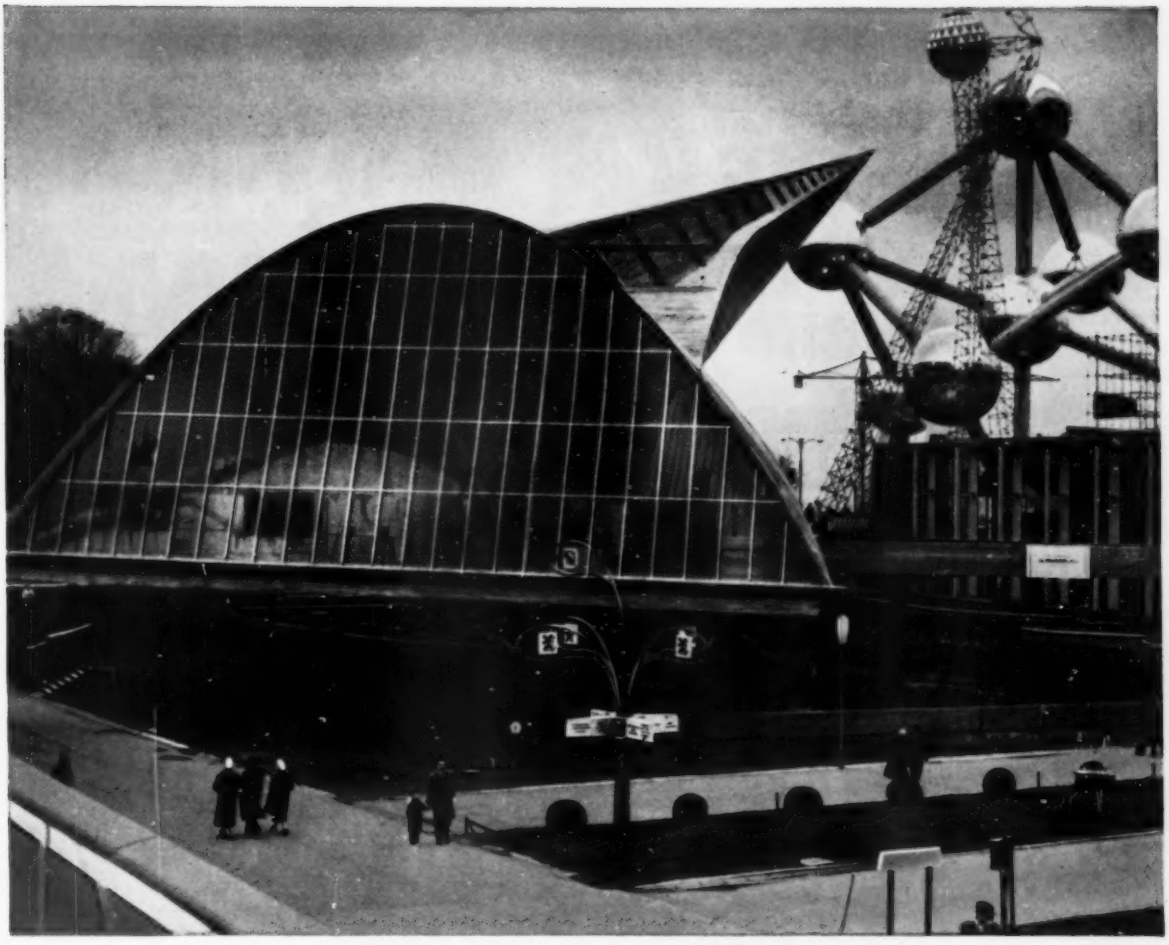
NOW READY – ANOTHER LOMBARD TRIUMPH IN ENGINEERING
THE NEW 3220-125 HIGH SPEED 12-16 OUNCE MODEL

SPECIFICATION SHEET AVAILABLE ON REQUEST

LOMBARD GOVERNOR CORPORATION Ashland, Massachusetts



Civil Engineering Pavilion at the Brussels International Exhibition. The glazing material used was 'Perspex'.

The Civil Engineering Pavilion at Brussels Exhibition was glazed with Clear 'Perspex'

More than 100 sheets used

One of the great architectural achievements of the Brussels International Exhibition was the civil engineering pavilion which is of concrete cantilever construction. Because of its low density, 'Perspex' acrylic sheet was specified as the glazing material In fact, more than 100 sheets of 3.2 mm ($\frac{1}{8}$") clear 'Perspex' were used. The result was an outstandingly exciting effect—modern architectural design at its very best. 'Perspex' has an extremely high light transmission and resists atmospheric corrosion. It is light yet robust and easy to heat shape. It will last indefinitely without discolouring and is easy to clean.

'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

Imperial Chemical Industries Limited, Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

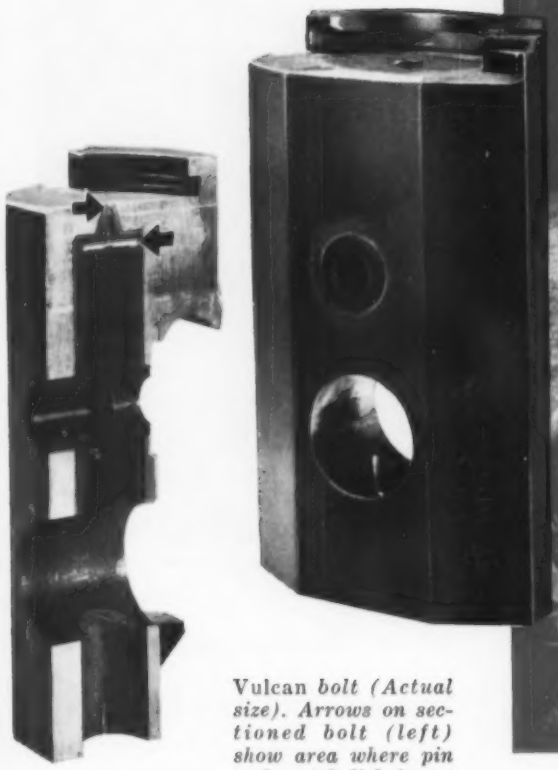
U.S.A. enquiries to:
J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to:
Canadian Industries Ltd., Plastics Division, Box 10, Montreal, P.Q.

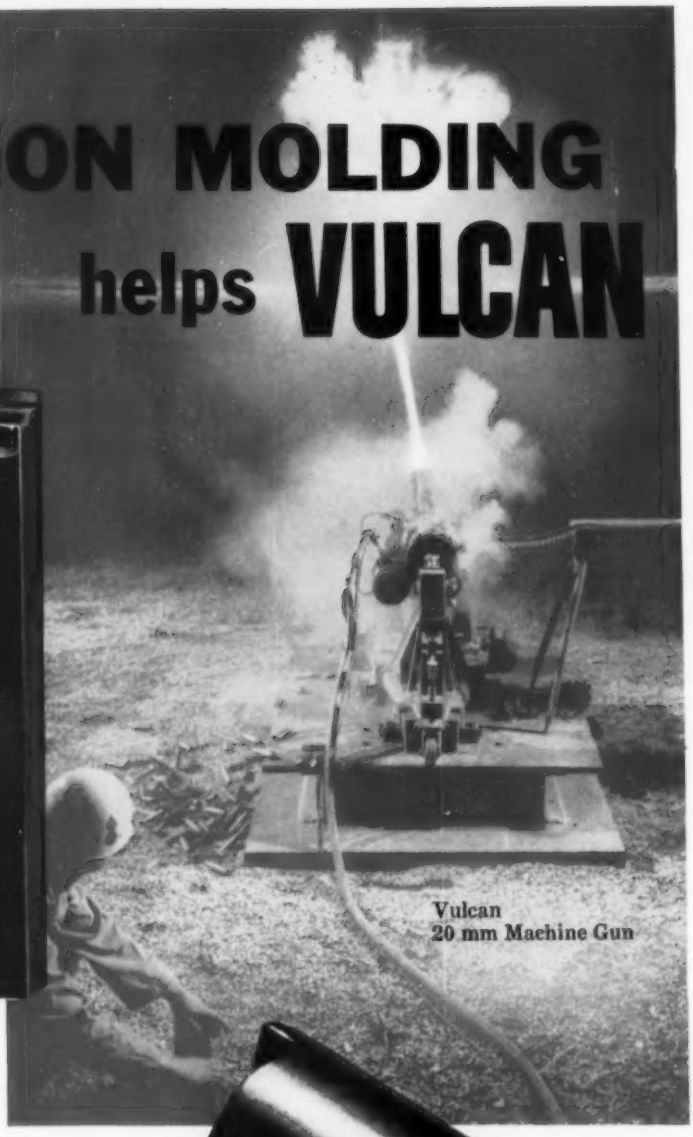
ICI

O.P.42/A

PRECISION MOLDING helps VULCAN



Vulcan *bolt (Actual size). Arrows on sectioned bolt (left) show area where pin and metal disk insert are precisely located in plastic.*



Vulcan
20 mm Machine Gun

Vulcan *firing pin (twice size), right, and sectioned firing pin, left, showing plastic liner. Rides in long Kel-F* liner in the bolt.*

THE FELLOWS GEAR SHAPER COMPANY, Plastics Machine Division,

Head Office and Export Department: Springfield, Vermont • Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.

fire 6000 shells a minute

Designed for fighters that fly faster than sound, General Electric's 20 mm *Vulcan* machine gun fires a fantastic 6000 rounds a minute! Even a one-second burst—100 rounds—will tear a target to shreds.

Because the Vulcan is electrically fired, its bolt and pin must be insulated with precision liners of Kel-F.* Requirements are exacting, with some tolerances as tight as 0.001". The location of a metal disk insert and the flowing of an 0.012"-thick section of Kel-F around an 0.078" pin at one end of the bolt combine to make this one of the most difficult jobs in plastics molding.

General Electric's Missile Production Section, Burlington, Vermont, selected G-W Plastic Engineers, Bethel, Vermont to do the job because of their tooling and molding "know-how" and their reputation for precision work. G-W uses Fellows Injection Molding Machines exclusively for this demanding work.

Here, as on other molding jobs, intricate or "easy", Fellows versatility pays off. Each Fellows machine is the fastest fully-automatic injection molding machine in its capacity range, designed for safe, high-speed production with minimum rejects. Your Fellows Representative can give you full information. Write or phone any Fellows office.

*T.M. Reg. Minnesota Mining and Manufacturing Co.

Fellows 12-350 Injection Molding Machine. Capacity: 12 to 20 ounces. Dry run speed: 600 to 800 cycles per hour.

Fellows

injection molding equipment

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VINYL UPHOLSTERY PRODUCERS *who use Plastolein 9720 Polymeric have two unbeatable allies on their side*

Time—the final judge of quality.
Plastolein 9720 Polymeric has excellent permanence, thanks to low volatility, low migration, and outstanding resistance to "wipe-off," heat and ultraviolet light. These qualities are a great comfort to our customers because they *know* their products will far outlast competitive products using monomeric plasticizers.

Cost—the powerful competitive edge.
Plastolein 9720 is the *lowest cost* polymeric plasticizer on the market today. In addition, its relatively low viscosity makes processing easier and permits the economies of bulk shipping, storage and handling.

Why not get both these advantages on *your* side? Write Dept. F-4 for booklet titled "Plastolein Plasticizers."

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Plastolein® plasticizers

Organic Chemical Sales Department, Emery Industries, Inc. Carew Tower, Cincinnati 2, Ohio

Vopcolene Division, Los Angeles—Emery Industries (Canada) Ltd., London, Ontario—Export Dept., Cincinnati 2, Ohio

April 1959, Volume 36, Number 8

MODERN PLASTICS

New techniques
and refinements of old ones,
including automation,
are paying off in

DECORATING MOLDED PRODUCTS

Virtually every type of molded plastics product can be decorated in one way or another. Seven of the more well-known decorating techniques, which will be discussed in this article, are vacuum metallizing; painting; silk screening; offset printing; hot stamping; transfer labeling; and molded-in decorations. Compounding the formulation for color before molding is not covered. Mention should be made, however, of some of the methods currently being used to add over-all color to a piece *after* it is molded. In most cases, plastics that are difficult to color by conventional techniques are involved. Rexton Finishes, Inc., Irvington, N. J., for example, makes available an epoxy color finish for phenolic that can be sprayed on the product. And Colorite Industrial Dyers, New York, N. Y., has developed methods for dyeing or tinting a wide variety of thermoplastic and thermoset parts.

The "big four" of decorating—vacuum metallizing, spray painting, silk screening, and hot stamping—can, with certain exceptions, be ap-

FRONT-SURFACE and rear-surface metallizing and spray painting make it possible to simulate a three-piece assembly—bezel, dial face, and window—in a one-piece molded radio dial. Case study is given on p. 179.

(4-color plates, Rohm & Haas)

(Photo, Olsenmark Corp.)

EXAMPLES of the hot stamping art as used on displays and cosmetics boxes show the unusual effects and close-tolerance work that can be obtained through precision engineering of the hot stamping dies.

(4-color plates, Rohm & Haas)

DOUBLE-SHOT MOLDING, spray painting, molded-in texture, and vacuum metallizing transform acrylic dispenser housing into handsome counter display. For details see p. 184.

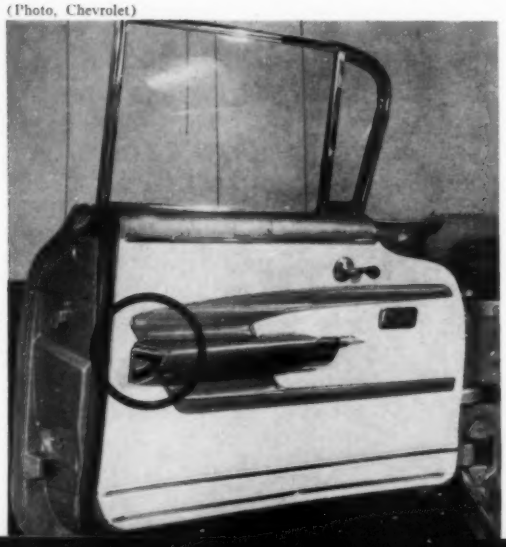
plied to most types of thermoplastics. In the thermoset field, spray painting and silk screening can generally be used; vacuum metallizing and hot stamping, however, are very rarely used for melamine and urea, although they have proved applicable for the other thermosets. Transfer labeling has thus far been used primarily on polyethylene; and the molded-in foil decorating technique has been largely limited to melamine and urea. Moreover, offset printing is generally applied to thermoplastics materials.

Polyethylene is still somewhat the bug-a-boo of the industry. With the exception of hot-stamping, which can be applied directly to a polyethylene piece after it is molded, most other techniques require that the surface be pretreated (oxidized) in some way (usually by flame or electronically) so that the paints, inks, or coatings will adhere to it.

Despite the limitation, however, the art of decorating polyethylene seems to advance further each year. Much of the activity appears to be taking place in the field of silk screened polyethylene squeeze bottles. It is even possible today to pretreat polyethylene so that a proper selection of organic coatings that will yield good metallizing results can be laid on the surface.

Reinforced plastics, when premix molded in matched metal or compression molds, can be metallized. Reinforced plastics parts made by bag molding or laminating, however, are likely to outgas air in the vacuum chamber while being metallized, causing blisters or craters in the top coat. Reinforced plastics can also be marked with letters, numbers, etc., by a new photoengraving process developed by Gray Pantograph Engraving Co., Poteau, Okla. Using

(Photo, Chevrolet)



REFLECTIVE TRIM (circled) in automobile armrest involves application of a special reflective material to V-shaped center of piece and vacuum metallizing the rest of the unit.

special inks which penetrate the surface of the plastic and become integral with it, the technique is used on RP signs to compete with porcelain steel signs.

Automating decorating equipment

Of perhaps the greatest significance to the recent decorating developments has been the emphasis of machine designers on automating equipment and fitting it more profitably into the production line.

Vacuum metallizing: According to NRC Equipment Corp., Newton Highlands, Mass., the picture is as follows:

"Spray coating, flow coating, and dipping equipment are now automatically regulated, the only manual operations being unloading and loading. And the same is true of vacuum coaters which are available with semi- and fully-automatic panels that control the vacuum cycle and rate of metal deposition. Then too, faster pumping rates with higher fore-pressure tolerances have resulted in equipment that not only is several times as fast as that of a few years back, but requires less maintenance. Development of the rotary gas ballast pump, along with the mechanically refrigerated cold trap, has also minimized the problem of condensation and the consequent reduction in pumping capacity."

With today's machines, depending, of course, on their size, it is possible to metallize more than 150,000 sq. in./hr. in a single unit. It is now also possible to handle larger pieces than ever before. On a 72 in. coater, for example, the six stations in the machine can hold work pieces up to 22 by 50 inches.

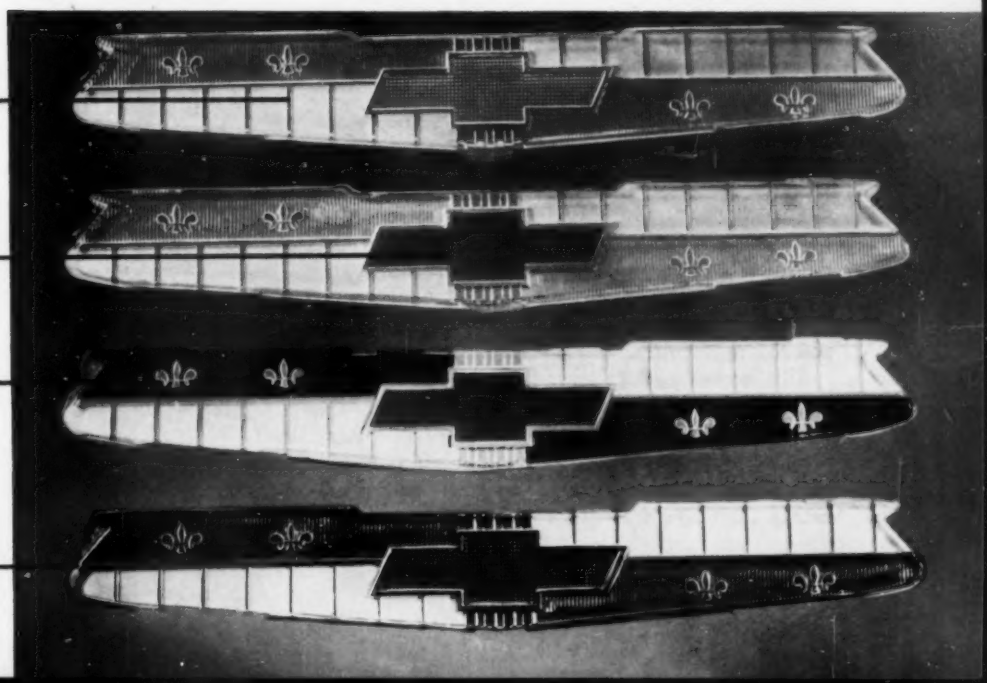
Spray painting: Average production on conventional spray painting equipment is about

FLOCKING, as here applied to molded expandable styrene toy bank, is new decorating technique which is first being researched by the plastics industry.

(Photo, Koppers and La Della Plastics)

DECORATING a clear acrylic piece (top). Part is first sprayed in white and blue on rear surface, while parts not to be so colored are masked off. Red is then sprayed on, with fleur-de-lis decoration and all other non-red areas masked off. Amber tinted topcoat is then sprayed on over fleur-de-lis decoration and border area around blue center. The entire unit is then vacuum metallized. Where topcoat has been tinted (fleur-de-lis and borders), the color shows through as gold. In all other areas, not yet colored, e.g., vertical lines in white sections, color shows through as aluminum.

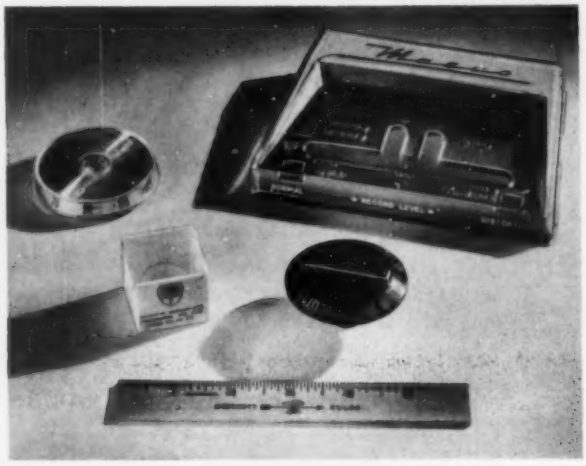
(Photo, Rohm & Haas)



(Photo, Rohm & Haas and Kent Plastics)

SPRAY PAINTING and metallizing are effectively combined in rear-surface decoration (rear view, left) of this clear acrylic plaque. A full case study of the piece is given on p. 180.

(Photo, Acromark)



FOUR WAYS to precision mark small, odd-shaped pieces: top left, gold paper on which numbers have been printed is inserted into clear piece; top right, double spray operation on rear surface of clear piece, using precision masks, produces tradename in gold and lettering in white; bottom left, nylon part is hot stamped in two colors; bottom right, dial is easily hot stamped in gold on cone-shaped edge.

400 to 500 pieces per hour; equipment is available, however, that can handle up to 3000 pieces per hour on specialized jobs.

Finish Engineering Co., Inc., Erie, Pa., offers one example of what modern equipment can accomplish. The problem was the application of five different translucent colors plus opaque black to a color slide being molded for General Electric by Nosco Plastics, Inc., Erie, Pa. To do the job, Nosco used one of Finish Engineering's spray painting units modified to allow spraying of three colors on a closely spaced area (details are given on p. 96).

Similar activity in automation and specialization has been noted at the plant of Conforming Matrix Corp., Toledo, Ohio, where two new machines have recently been made available: 1) a combination of automatic spray painter and mask washer in which a rotating plate indexes the piece through the spraying operation and then through the various mask cleaning and drying steps, and 2) a double vertical fixture automatic spray machine that has enabled a manufacturer of model automobiles to reduce his finishing personnel by some six operators and still keep a production of from 300 to 800 painted automobiles per hour.

Silk screening: A hand-operated squeegee can turn out from 250 to 500 pieces per hour; with machine-operated squeegees, 400 to 1000 pieces per hour are possible. Automatic equipment is also available from many custom decorators. Just how fast this equipment can go is illustrated by the unit recently offered by General Research & Supply Co., Grand Rapids, Mich. The machine is a production-line marker that can print trademarks, designs, etc. by the silk screen process at the rate of 5000 cycles per hour.

Hot stamping: There are three basic types of stamping equipment—hand-operated, motor-driven, and air-operated. The average production run with semi-automatic equipment today is as high as 2000 pieces an hour—automatic equipment is available to do the job on small, standard-shaped pieces, e.g. toothbrushes, combs, etc. at a rate as high as 4500 to 5000 pieces an hour. Most machines of this type are based on replacing manual feeding lines with hopper feeding, conveyor feeding, or rotary indexed turntables. The limiting factor on speed, of course, is the dwell time required for certain plastics.

Advances in decorating media

The second major area of development for the "big four" of decorating has been in improving the paints, inks, and finishes that go into the decorating process and adapting them specifically to meet the peculiar problems raised by plastics.

For vacuum metallizing, one of the most important advances has been the development of more durable lacquers—up to 8 to 9H pencil hardness—to protect the metallized finish. So tough are these new finishes that many de-

TECHNIQUE of molding printed paper foils into melamine dinnerware has been greatly refined. Delicate, colorful designs that show up clearly in end product are now possible.

↑ (Photo, Commercial Decal) ↓ (Photo, Plax Corp.)

signers, particularly those in the automotive industry, have already started to switch over from second-surface metallizing to first-surface metallizing. In the words of Morton B. Gilbert of F. J. Stokes Corp., Philadelphia, Pa., ". . . since the shift to first surface usage was made in 1957, at least two vacuum coating units have been sold to the automobile builders with a conservatively estimated quantity of seven large production-size machines going to custom decorators in the Detroit area who specialize in automotive finishing."

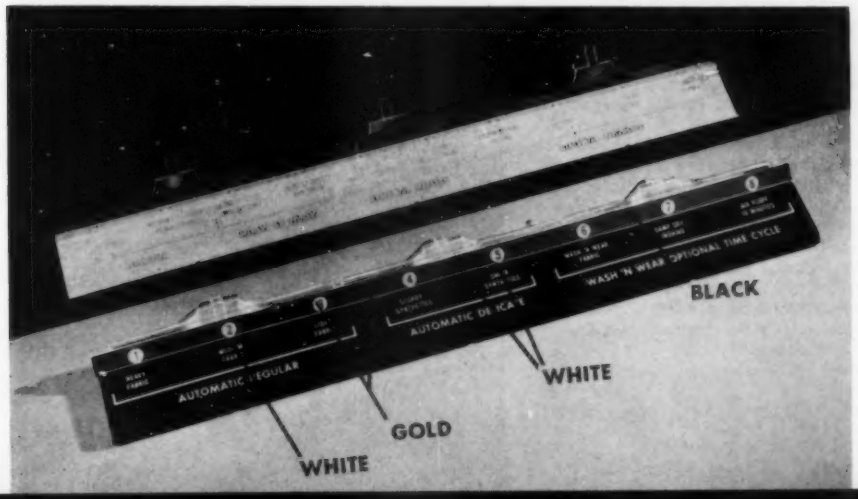
Foils for hot stamping: Five years ago, hot stamping on polyethylene or vinyl was a relatively difficult task. Today, it is so effective that it is almost impossible to abrade the hot stamped decoration from either material.

Credit for this development must go to the leaf manufacturers who recognized the differences in properties among the various plastics and accordingly diversified their lines so that they could offer a specific leaf for each specific plastic. Leaf manufacturers have also improved their product by research into the carrier materials which back up the pigment. To acetate and cellophane have now been added Mylar polyester films. Although it is more expensive than the other two, it can be

FOUR BASIC METHODS of decorating polyethylene squeeze bottles (from left to right): silk screening; hot stamping; transfer labeling; and offset printing.

DIAL for washing machine typifies high art of decorating. Molded clear, all decorating is done from the rear. Piece is first hot stamped in gold on top edge. Since numbers are molded in relief on the rear surface, they also take the gold stamp at the same time. Bottom of panel is then spray painted black. Lettering in this area is also molded in relief so that when the entire piece is passed under a milling cutter, the black paint is removed from the lettering, leaving them clear once more. Finally, the entire rear surface is spray painted translucent white. All areas not previously decorated, including the lettering and the depressed background around the numerals, pick up this white coloring. When the dial is in use, light shines through the white to illuminate it.

(Photo, Amos Molded Plastics)



used in thinner gages, it is much tougher, and makes possible more sharply defined detail.

From the appearance standpoint: 1) Metallic leafs are now available to permit spot metallization in molded items; 2) Leaf in transparent colors can be stamped on the underside of a clear plastic piece and then metallized from the rear to give interesting color effects; and 3) Leaf in daylight fluorescent colors is available for dramatic effects.

Comparative advantages

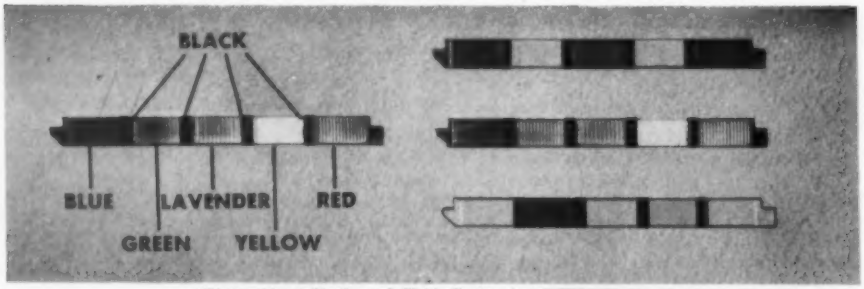
It is obvious that each of the "big four" decorating techniques has its own advantages—and its own limitations. For one thing, the selection of the proper decorating technique will depend on the end-product.

Even costs involved are relative. The cost of a vacuum coater, for example, usually runs much higher than equipment for hot stamping, silk screening, or spray painting, yet in the words of one supplier of such coaters, ". . . for small parts coated in modern-day equipment, the cost is on the order of 0.1 to 0.2¢ per sq. in., including the equipment, labor, and material for applying the base coat and the topcoat."

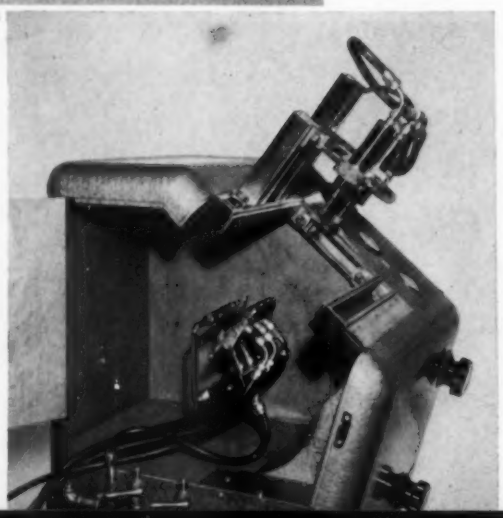
Similarly, hot stamping and silk screening costs are about equal, although one or the other may have the advantage in individual cases. Screens in themselves are less expensive than hot stamping dies; but silk screened decorations need an approximate 20-min. bake in a drying oven (or an overnight air cure) while the hot stamped decoration dries immediately. Since roll leaf is more expensive than inks for screening, the size of the area to be decorated will also have an effect on the final cost.

The number of colors required in the final decoration is also an important determinant. More than one color in hot-stamping calls for extra roll leaf and additional dies and stamping equipment to handle the extra colors; in silk screening, each extra color requires a separate pass and will raise the cost accordingly—yet an elaborate photographic screen is itself less costly than an elaborate precision mask used in spray painting. Offset printing, of course, is the only technique that can handle as many as four colors in a single pass, although multiple spray gun units in conjunction with special masks and baffles are making it possible to simultaneously spray more than one color on to a piece.

Where lettering is depressed on the front surface of a piece and where the length of the run justifies it, there is probably nothing faster and more economical than automatic filling and wiping machines to handle the coloring job. Where the lettering is molded-in (*To page* 174)



(Photos, Nosco Plastics and Finish Engineering)



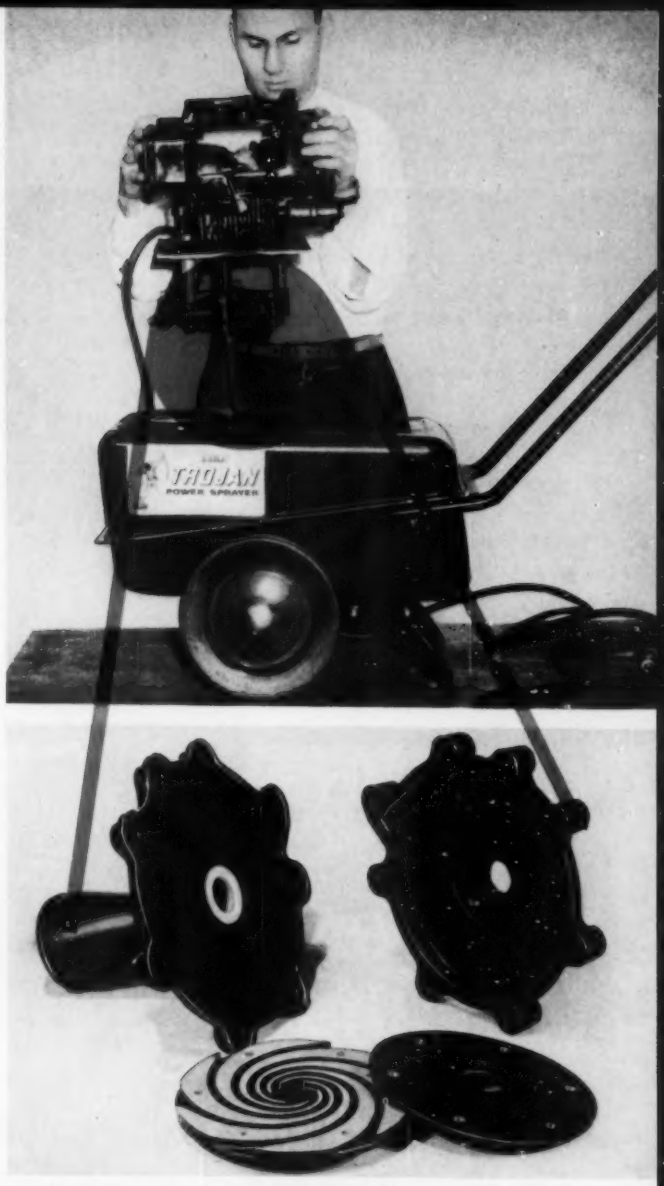
APPLICATION of five different colors plus black stripes to color slide (above, left) requires special equipment (right). The part is first sprayed with the four black stripes in a standard set-up using a spray gun with a wide fan. The middle end stripes are then sprayed through a mask with baffles between the colors. Finally, the part is resprayed with the two remaining colors. Masks were constructed so as to place areas to be painted in line with the spray guns in both color applications—thus eliminating any change in spray gun alignment between operations. Five colors can thus be sprayed in two loadings by just changing masks and paint colors. Production rates averaged out to about 1000 pieces per hour. Other color variations are shown above, right.

Why premix for pump?

Price for molds was slashed from $14,000 to $5600 when glass-filled RP molding compound was chosen over die-cast aluminum. Other benefits also resulted

Substantially lower mold cost was one of the principal reasons for choosing polyester premix over die-cast aluminum for the centrifugal spray pump used in the Bean-Oakes 10-gal. mobile sprayer for applying insecticides, liquid fertilizers, etc. According to spokesmen of John Bean Div., Food Machinery & Chemical Corp., Lansing, Mich., developer of the pump, a low-pressure premix compound permitted use of matched-metal molds that cost about 60% less than the dies required for aluminum die casting. Quoted price for the die-casting molds (high grade steel) was approximately $14,000; actual costs for the premix molds (low-carbon steel in thinner sections) was approximately $5600. Basic reasons for this difference are the respective strength requirements for the mold: aluminum is die-cast at about 2000 p.s.i.; the premix used in this application is molded at about 500 p.s.i.

All major components of the pump are molded of Atlas' Thermaflow 100. Flanges, rims, bosses, and bolt holes are molded-in; only a few tapping operations are required.



PUMP UNIT, circled in color in top photo, has five major parts molded of premix. These (lower photo) are: two-piece impeller assembly (foreground); two-piece housing (volute, upper right, and impeller base, upper left); and intake tube cemented to impeller base. White ring in center of impeller base is a molded nylon bearing.

Cost savings in assembly

Additional cost savings are brought about by the simplicity of the unit. The only moving part of the pump is the impeller, which is coupled directly to the drive shaft of a 2½-hp. gasoline engine. The absence of belt drives, pulleys, pistons, connecting rods, etc. found in piston pumps, simplifies production and assembly, and also reduces maintenance.

The polyester premix material has a number of other advantages for this application. Surfaces of the molded parts are smooth and present minimum resistance to flow of liquids. Mechanical strength is high, and broad chemical resistance of the material permits handling of materials which would seriously corrode many metals.

The premix parts are compression molded by Grand Haven Plastics, Grand Haven, Mich. Molding pressures range from 20 tons for the $\frac{5}{32}$-in. wall intake tube to 35 tons for the volute and impeller housing—which have maximum thicknesses of 1 inch.—END

Foam chair frame is ⅔ lighter, 5 times stronger

Revolutionary technique for making frames for upholstered furniture promises to bring into the medium price range chairs and sofas previously offered only in expensive lines

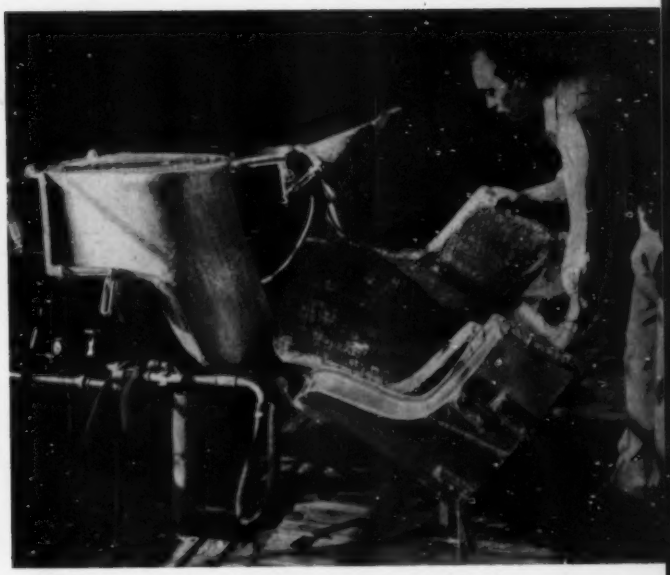
Frames for upholstered furniture that are five times as strong as those made from wood and that result in finished pieces whose weight is only about one-third that of wood-frame-based types are now being molded of expandable polystyrene.

Introduced by Futorian-Strafford Furniture Co., Chicago, Ill., and produced at its Tupelo, Miss., plant, using Koppers Dylan material, these new frames mark a radical departure from traditional concepts. The frames promise, in fact, to become one of the few significant major advances in the manufacture of upholstered furniture to transpire in more than a century.

The thinking behind this switch from wood to foam was outlined in a recent statement by Morris Futorian. Said he: "Until now, when a designer planned an upholstered chair with a gracefully curved back, he could anticipate trouble. First, preparing the frame is difficult and expensive. If the frame is to be made of solid wood, you can assume, because of the

EASE WITH WHICH foamed polystyrene chair frame is held aloft dramatizes its lightness as compared with conventional wooden frames. Finished chair is in foreground. Despite light weight, foam frame is far stronger than wood.

PRE-EXPANDED polystyrene beads—about 4 lb. for each chair frame—are poured into cast aluminum mold. Steam required to fully expand beads enters mold through hoses at bottom.



HINGED MOLD, made in three sections, is opened and chair frame removed. Burlap on frame surface is fused to foam during molding cycle. Tiny holes in mold distribute steam.

grain, that it will be weak and will not give satisfactory service.

"Second, if the frame is made of a laminate or plywood, manufacturing expenses will be high, frames will not be uniform, structural strength remains a problem, and there still must be a compromise between design and ability to form the wood to a desired shape. Finding a practical way to provide design versatility has been a problem of the industry ever since the first piece of upholstered furniture was made. The limiting factor has been the frame. Now that problem no longer exists. Our first products are chairs. The process is being adapted so that it can be used on sofas also."

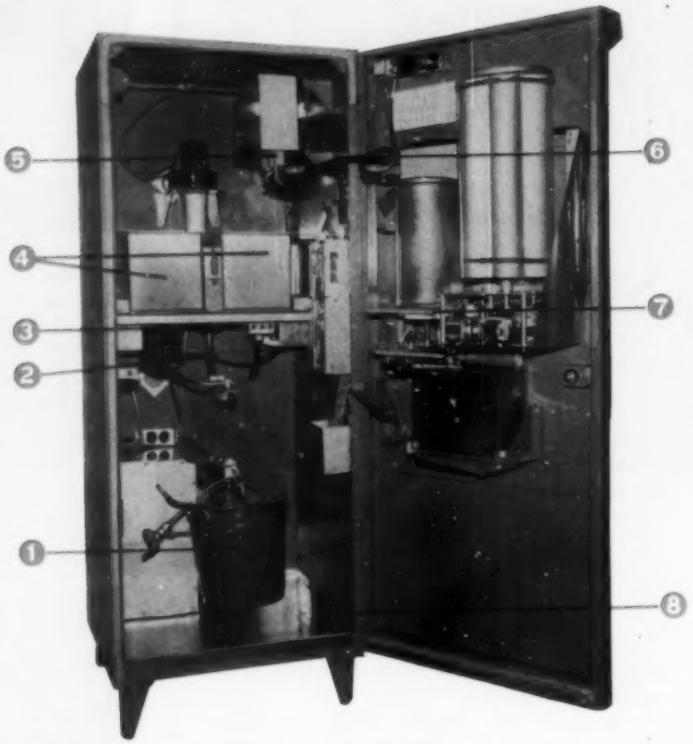
Eight hundred chairs per day

Currently, Futorian is using two basic molded expandable styrene shells, from which several styles of living room chairs are produced, using separate foam latex cushions in the seats and polyether urethane foam padding in the backs. Thanks to manufacturing economies made possible by the foam plastic shell, they retail at between $60 and $90—a price range attractive to the middle income market. Production, now in limited quantities, is expected to reach approximately 800 chairs daily within two years. (*To page 198*)

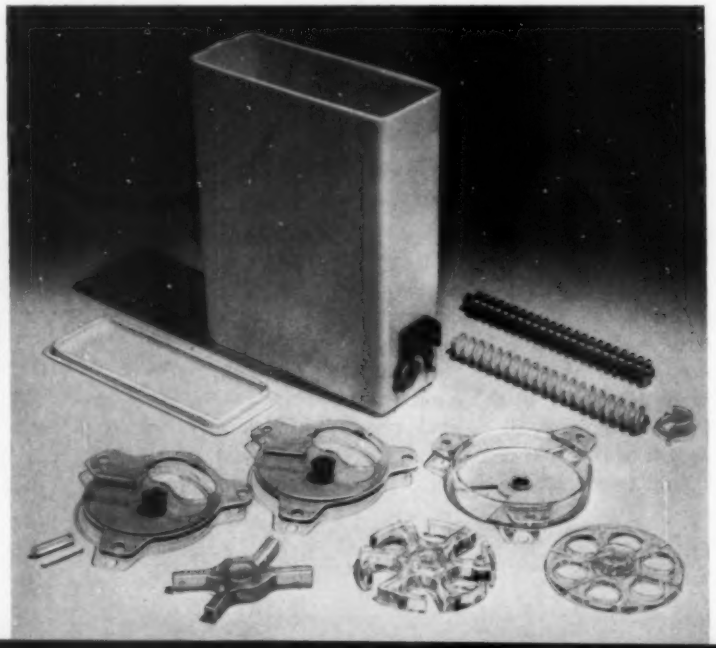
UPHOLSTERY operations are simplified because foam frame is fully contoured. Wooden base to which operator is tacking upholstery fabric was cemented to the frame after the molding operation had been completed.

How redesign in vending

MULTIPLE SELECTION coffee vending machine, showing decorative molded acrylic front bezel, acrylic lift-up delivery door, embossed metallized Mylar front trim panels, and extruded styrene lens for fluorescent light across the top of the cabinet.



INTERIOR of multi-selection vending machine. 1) Polyethylene waste pail; 2) vinyl hose; 3) melamine mixing bowl, partly hidden by shelf; 4) two of the four modified acrylic ingredient containers used; 5) molded nylon electrical connectors; 6) vinyl wire insulation, used throughout; 7) rotary dispenser; and 8) Mylar floor covering. Table on page 103 gives the savings as well as the advantages.



INGREDIENT CONTAINER (top center), molded of modified acrylic, replaces former stainless steel unit. (See also photo on facing page.) Styrene cover is at left of container. In right background is new ingredient auger, also molded of modified acrylic, and the machined aluminum auger which it replaces. Small part at end of auger is a molded nylon baffle. In the foreground are rotor housings, rotors, and covers, molded of methylstyrene (see footnote in tabulation on p. 103) and used to dispense various selected ingredients in precise amounts.

machine parts resulted in better performance at

Savings up to 75 percent

Reducing the cost of an important component 70% by switching from metal to molded plastics, with equal or better product performance, represents a saving few manufacturers could afford to pass up. Yet this is typical of the advantages gained by The Bert Mills Corp., St. Charles, Ill., when such switches were made for many parts used in its line of coin-operated coffee and hot beverage vending machines.

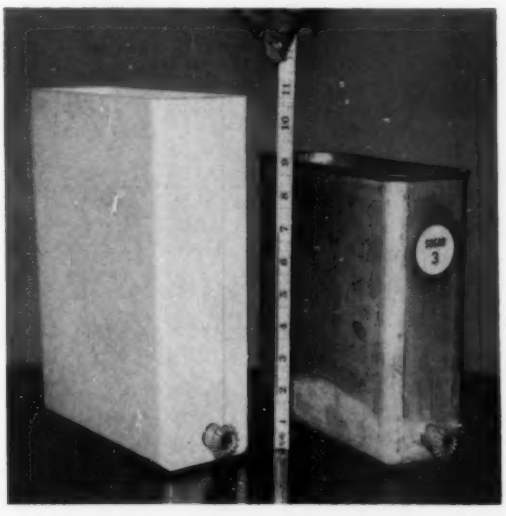
Modified acrylic saves 70 %

One of the most interesting of these changes involves the ingredient containers used in the Coffee Bar machine. This multi-selection unit automatically dispenses coffee, tea, or soup; the containers hold the basic ingredients, plus sugar and cream.

These containers are now injection molded of white Implex-A modified acrylic material by The Richardson Co. at its Indianapolis, Ind., plant. Previously they were fabricated of stainless steel sheet stock, requiring a costly six-stage drawing operation. Faced with the necessity of replacing the draw dies at an estimated cost of from $12,000 to $15,000, Bert Mills studied the possibility of molded plastic containers. Analysis of costs and other factors resulted in selection of the modified acrylic, permitting the parts to be injection molded. As an additional bonus in the changeover, the depth of the containers was increased from 8¾ to 10¾ in., enlarging their capacity approximately 25 percent.

This materials switch slashed costs per unit to only 30% of the original figure. Weighing 23 oz. each (as against 27 oz. for the stainless steel units), the plastic containers are molded with an aluminum insert and five cored openings near the bottom, using a side plate type mold running in a 48-oz. injection machine. After molding, a stainless steel bushing is pressed into the aluminum insert to obtain a boss on the outside; a stamped mounting bracket is bolted to the other side. On the previous metal container, spot welding and spinning operations were necessary.

COMPARISON OF NEW CONTAINER, molded of modified acrylic (left), with fabricated stainless steel unit which it replaced. Capacity is 25% greater; cost to the end-user is 70% less.



72.5 % saved on auger

Mounted in the bottom of each container is a spiral auger which ejects a measured volume of powdered coffee or other material through a baffle as it rotates. This part is now injection molded of Implex-A acrylic by Richardson, using a mold produced by the Shaw process. Earlier augers were machined from aluminum rod stock by rotary milling. Cost was reduced to 27.5% of original price with the plastic parts. With volume requirements running around 2000 units annually, it is estimated that mold costs for the plastic auger can be amortized in about one year. Flanged, lift-off type covers for the ingredient containers, injection molded of styrene, are supplied by Werner Mfg. Co., Brookfield, Ill.

Nylon is used for the auger baffle, which serves as an outboard bearing on one end of the

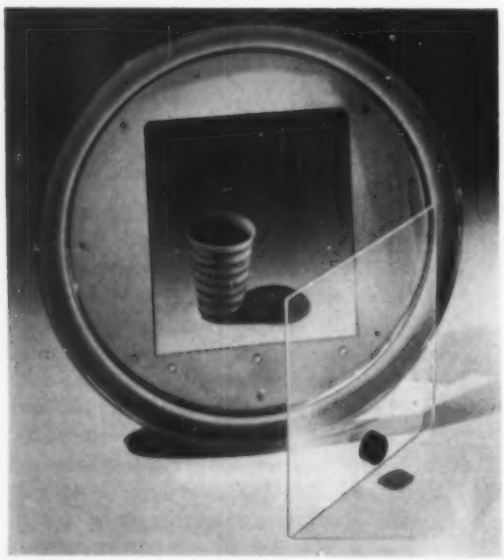
EXPERIMENTAL mixing bowl made of melamine (top left) does not pose staining and maintenance problems as does stainless steel bowl at top right. Vinyl tubing (center) is used as food hose in various vendor models. Resting on filled melamine brew plate (foreground), which replaces aluminum plate, are melamine brew cylinder and cap which are under study but have not yet been adopted.

auger; Werner is the molder. Several dispenser housings, rotors, and covers, which when assembled function to release the measured ingredients for mixing with hot water to produce a ready-to-drink beverage, are also made of plastics. Powdered or granular material carried in the rotor pockets passes through an orifice in the housing as the rotor reaches its dispensing position. Until American Cyanamid discontinued the sale of methylstyrene in February of this year, these parts were injection molded by Werner of Cymac 201, which provides a desirable combination of transparency, toughness, and heat resistance. With the nonavailability of the material, the molder is currently investigating styrene-acrylonitrile and polypropylene for this application.

Melamine bowl leads to 75 % saving

One of the most important components of the Bert Mills machines is the mixing bowl, where powdered coffee and hot water combine in the powdered coffee machine. This part was originally made as a spinning of stainless steel sheet stock and given a fine rouge polish on the inside surface. However, it accumulates a deposit in use which must be removed in regular servicing of the machine. The part is also susceptible to denting or bending if accidentally dropped during servicing.

Recently, the company began testing a new mixing bowl compression molded of white



CLOSEUP of molded acrylic front bezel for vending machines, decorated in gold on second surface, shows beauty of this part, which supplants previous anodized aluminum bezel of similar design. Clear acrylic part in foreground is lift-up door through which patron removes filled cup from the machine.

COFFEE hopper for fresh brew machine, fabricated of 0.015-in. vinyl film, is mounted above dispenser mechanism by built-up vinyl grommets at top and clamping band at bottom.

Plaskon melamine by Van Norman Molding Co., Chicago, Ill. Cost of this part is less than one-fourth that of the metal bowl. Further, the plastic bowl, automatically flushed with clear hot water after each vending cycle, shows no tendency to stain or pick up deposits under continued use. Indications are that it will supplant the stainless steel part within the immediate future.

Bert Mills and Industrial Molded Products Co., Inc., Palatine, Ill., have been collaborating in an attempt to develop a molded plastic brew cylinder for the fresh brew machine. This would replace a unit composed of a stainless steel sleeve and a cast aluminum cap, assembled with a stainless steel strainer and neoprene gasket and fastened with stainless steel screws. The stainless sleeve and cap now used require a considerable amount of precision machining and other fabricating. Plastics which might be used for a replacement brew cylinder are still being evaluated.

The brew cylinder and associated parts are mounted between two flat brew plates molded of Fiberite 2015 cotton filled melamine by Richardson at Melrose Park, Ill. Molded with a number of cored openings, they replace sheet aluminum plates used earlier, and cost only one third as much.

For better decoration

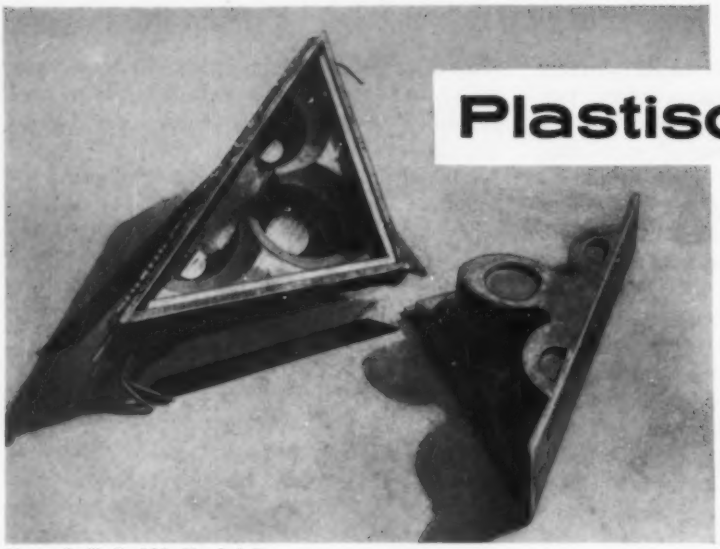
Bert Mills has recently replaced the round anodized aluminum front bezel with a new acrylic unit, second-surface-decorated in gold or silver on different models. This part, approximately 15 in. in diameter (*To page* 196)

Parts of vending machines and how much was saved by switching from metals

Name of component	*Plastic used*	*Material prev. used*	*Savings*
Ingredient container	**Implex "A" modified acrylic**	Stainless steel	**70 %**
Ingred. container cover	**Styrene**	—	**Original**
Ingredient auger	**Implex "A" modified acrylic**	Aluminum (machined)	**72.5 %**
Auger baffle	**Nylon**	—	**Original**
Dispenser housings, rotors, covers	**Cymac 201 methylstyrene***	—	**Original**
Mixing bowl (experimental)	**Plaskon melamine**	Stainless steel	**75 %**
Brewer plates—top and bottom	**Fiberite 2015 cotton filled melamine**	Sheet aluminum	**67 %**
Front bezel	**Plexiglas**	Anodized aluminum	**Not significant but better performance**
Vending door	**Plexiglas**	—	**Original**
Front panel trim and interior floor covering	**Embossed metallized Mylar**	Embossed metal	**Not significant but better performance**
Lens for fluorescent light	**Extruded styrene**	—	**Original**
Coffee hopper	**0.015 vinyl film stock**	—	**Original**
Food hose	**Extruded vinyl chloride**	—	**Original**
Waste container	**Regular and linear polyethylene**	—	**Original**

* In February of this year, American Cyanamid announced discontinuance of methylstyrene production. Molder is currently evaluating styrene-acrylonitrile and polypropylene for this application.

Plastisol molds



PLASTISOL mold for casting concrete (at right in photo) was produced in aluminum master at left. For balustrade job described in article, 20 such plastisol molds were produced to be used in groups of four, as in photos below.

Photos, B. F. Goodrich Chemical Co.

Precise duplication of priceless hand-carved stone-work in "mass-production" quantities and at low cost has become practical through the use of vinyl plastisol molds. Concrete, colored as desired, is cast in these molds to make almost any number of reproductions for use in decorative building applications.

The technique is now being used in the construction of an addition to the Church House of the First Presbyterian Church in New York, N. Y. Architect Edgar A. Tafel wanted to duplicate a massive hand-cut stone balustrade which was a feature of the original century-old building. Present-day labor costs ruled out the methods that were used 100 years ago. Cast concrete offered an alternative, with Precast Building Sections, Inc., New Hyde Park, N. Y., commissioned to do the casting.

The new balustrade required some 130 separate but identical sections, each about 3 ft. square by 6 in. thick. Because of the large number of pieces that had to be made, it was decided, according to Virgil Carrol, general superintendent of Precast, that wooden molds, often used for precasting concrete, would be too expensive and time-consuming. Wooden molds require repair after only a few uses and would have to be replaced after a maximum of 20 castings had been made. In addition, the careful handling necessary in removing the molds from the cast concrete and the considerable amount of hand finishing necessary on the cast concrete pieces would have presented real production bottlenecks.

The plastisol molds were produced by Boonton Molding Co., Boonton, N. J. A section of the

FOUR plastisol mold sections (see photo above), assembled in wooden frame, are coated with wax to facilitate later removal from concrete.

CONCRETE mix is shoveled into four-part vinyl plastisol mold, in which preformed steel reinforcement has been placed.

for fancy "stonework"

By switching from wooden molds to vinyl for casting concrete, intricate carvings are duplicated at reduced cost

old balustrade was first removed from the original building to serve as a guide for making a wooden pattern. With every detail worked out in wood, a sand mold was made from the pattern and an aluminum master mold was cast.

For economy and ease of handling, the aluminum master mold represented only one-quarter of the balustrade section; in casting the concrete, four plastisol molds are fitted together to produce a complete section in one solid piece of concrete.

In making the final plastisol molds, a form of slush molding was used. The aluminum master was first placed on a level heated table and preheated to 340° F. It was then filled with 35 lb. of plastisol, which was allowed to gel against the metal mold surface for about 20 minutes. The master was then inverted and the ungelled material slushed out. A 1-hr. oven cure followed, the mold was cooled, and flash trimmed off. Removal of side plates then permitted the cured vinyl piece to be stripped out. This was repeated until 20 plastisol mold sections had been produced. The plastisol compound used, based on Goodrich Geon 121 resin, was supplied by Specialty Dispersions, Caldwell, N. J.

At the Precast plant, the vinyl molds were backed up with casting plaster to withstand the weight of concrete to be poured into them, and were ready for use.

In preparation for concrete pouring, four of the vinyl molds are placed in a wooden form—the 20 pieces make up five forms for faster production—and the surfaces coated with a wax mold release. Preformed steel reinforcing bars are then set in place and the mixed and colored concrete is shoveled in. After a 12-hr. curing time, the vinyl molds are knocked out and reassembled for the next pour.

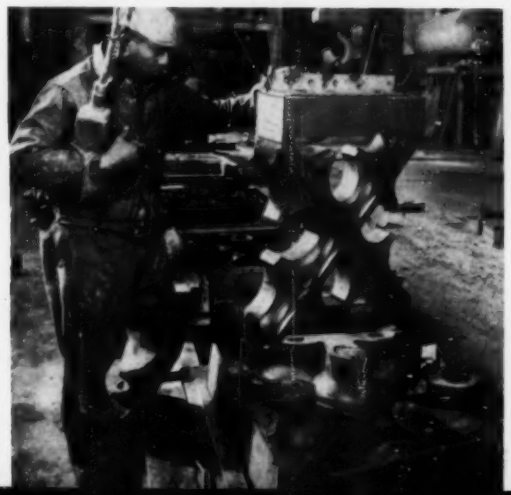
What was the cost?

If wooden molds had been used for this job, several would have been required. Each one would have cost $125 and would have had all the disadvantages previously mentioned. Total cost for the aluminum tooling was $315, and the vinyl mold sections were $22.50 each, or $90 for each complete form.

Advantages of vinyl plastisol molds for precast concrete are summarized by Evert L. Bono of the Special Products Div. of Boonton, as follows: 1) Molds are flexible and can be peeled from undercuts. 2) Surface of molds can duplicate almost any desired finish. 3) Molds can be removed from "green" castings with a minimum of strain on the concrete.—END

ONE section of vinyl mold (right foreground) has been removed from concrete; second is being stripped. Wax mold release facilitates stripping.

MOLD parts have all been removed from precast concrete and are ready for immediate re-use. Forms in background are ready for pouring.



REPLACEABLE cells with cases molded of high-impact polystyrene are features of new Cellomatic car battery, produced in 6- and 12-volt sizes. Complete battery is cradled against shock in frame (background) molded of polyethylene. Defective cells can be replaced individually in minutes.

Why latest batteries have plastics structures

REINFORCED PLASTICS housing and cover are used in Silvercel aircraft battery. Pencil points to polyethylene vent plug.

CELL of battery at left. Case is molded of styrene copolymer.

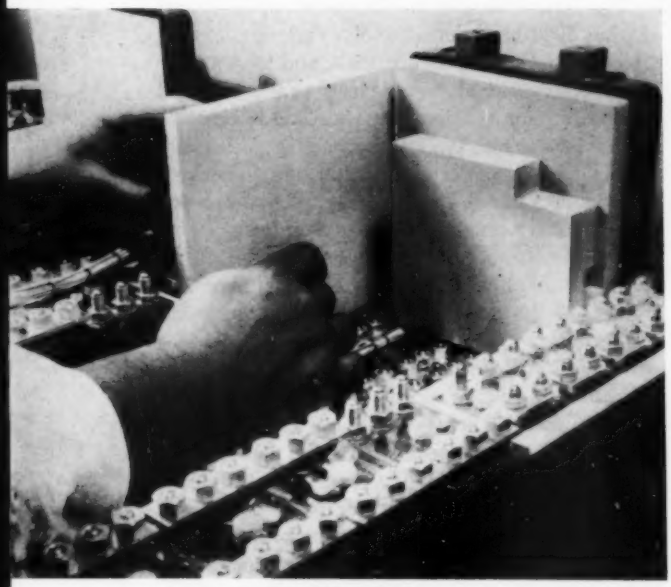
Used as engineering materials, plastics make important contributions to the development of new storage batteries of advanced design

Three manufacturers have recently incorporated plastics as structural and functional components of their latest storage batteries. In each case plastics were chosen in preference to other materials because their use resulted in a better product and, in turn, in improved sales. Cost saving was not a primary issue.

The Yardney Silvercel

The 14xHR15V silver-zinc aircraft battery produced by Yardney Electric Corp., New York, N. Y., is used, for one example, in Bell Helicopter Corp.'s 47J helicopter. The battery, which weighs only 11.5 lb. and has a volume of only 166 cu. in., makes use of nine plastics in 13 separate applications. About 25% of the battery weight is represented by plastics.

The accompanying table, listing these applications, details the reasons for the choice of the



URETHANE FOAM, machined to shape, is used as spacers in many batteries of Silvercel line.

PLASTICS IN THE YARDNEY SILVERCEL BATTERY: WHAT, HOW, WHY?

Battery housing and cover: **Compression molded of polyester reinforced fibrous glass**
- light weight
- good electrical insulation properties
- resistance to mechanical, thermal and shock stresses

Cell housing: **Injection molded of styrene copolymer material**
- low specific gravity
- high tensile and flexural strength
- resistance to heat, crazing and battery electrolyte
- ease of sealing cover to case, using solvent sealing techniques

Internal cell shims: **Ethyl cellulose**
- heat stability
- excellent resistance to electrolyte
- available in thin sheets

Seal for bonding cell cover to steel terminals: **Modified epoxy resin**
- excellent metal-to-plastics bond
- resistance to electrolyte, mechanical and thermal shock
- excellent dimensional stability
- can be handled and applied conveniently

Vent plug: **Injection molded of polyethylene**
- elasticity allows compression fit into undersized vent opening.

Vent plug cap: **Injection molded of nylon**
- rigidity for tight fit in undersized opening of polyethylene vent plug body

Vent plug packing material: **Polytetrafluoroethylene felt**
- allows cell to breathe; is not wetted by potassium hydroxide electrolyte

Extruded tubing for lead wires: **Polyethylene**
- resistant to attack by electrolyte
- colorable—red and black for identification of positive and negative leads

Polarity markers, name plate: **Vinyl acetate-vinyl chloride copolymers**
- resistance to electrolyte attack
- ease of heat stamp lettering
- good appearance and finish at low cost

Brush potting protection for exposed cell terminals and interwall connectors: **Epoxy resin**
- good mechanical properties
- excellent resistance to electrolyte
- protects parts from moisture, salt atmospheres, etc.

Front spacer: **Urethane foam**
- low weight
- good electrical characteristics
- resistance to potassium hydroxide
- flame resistant
- high stress resistance
- excellent machineability; will not crumble or chip out

Packing material for final assembly: **Polyethylene film**
- moisture resistant

POLYSTYRENE containers and high-impact styrene covers have replaced glass in all stationary batteries produced by Exide. The battery covers are cemented in place.

specific materials for their particular jobs—from cell construction to final packing. According to the manufacturer, the use of plastics in this battery is typical of their application in the complete line of Yardney batteries.

The Exide PWA

The Exide Industrial Div. of The Electric Storage Battery Co., Philadelphia, Pa., is using plastics for major component parts in its new flat-plate stationary PWA storage battery for moderate cost small-power applications in industry. The company has long been a pioneer in the use of plastics for jars, covers, and other battery components (see, for example, MPL, July 1957, p. 99). The PWA batteries have heat-resistant polystyrene containers and super-high-impact polystyrene covers (items which were recently made standard on all Exide lines of stationary batteries) and feature a special explosion control device consisting of a polystyrene hood, or baffle, over the plates, which collects the gases and channels them through a cylinder vent. Covers are bonded to the jars by means of a specially formulated polystyrene cement. All polystyrene parts are injection molded in single cavity molds. Shots weigh up to 4 lb., 2 oz. for the largest PWA part. Polystyrene supplied from a variety of sources was chosen for its light weight, acid resistance, ease of manufacture and cementing, adequacy of physical properties for the application, and transparency that permits inspection of battery elements. While the PWA is a new model, glass jars were previously used for batteries for similar service.

The batteries are marketed in two- and three-cell containers, with either seven or 13 plates per cell. The seven-plate battery is rated at 50 amp./hr., at the 8-hr. discharge day. Thirteen plate sizes are rated at 100 amp./hr. Elements of the PWA batteries are suspended from the cover, while polyethylene supports at the bottom of the jar hold the separator in position. The PWA rounds out an extensive line of stationary batteries in plastics. The largest of these is rated at 1680 amp./hr. at the 8-hr. rate. It uses a molded polystyrene jar weighing 16 pounds.

The Cellomatic

In another instance, the use of plastics has contributed to the success of a revolutionary new battery design concept. A new car battery by Scranton Cellomatic Battery Corp., Archbald, Pa., features separate plastic-cased cells which can be replaced quickly and at moderate cost; moreover, this separate cell principle permits cooling air to flow on all four sides of the cell, increasing battery life.

Cases of the replaceable cells are molded of Koppers high-impact, heat-resistant Dylene 800 polystyrene, chosen for its light weight, acid resistance, and good electrical properties; also, a material which could be molded in thin sections was required since it was necessary that the cells *plus* the added air space not exceed the dimensions of standard batteries.

Cases for the 6-v. battery cells are produced in a single cavity mold with shots weighing 9 oz.; 12-v. battery cell cases in a double cavity mold with shot weights of 13 ounces.

The battery frame, molded of Koppers Super Dylan 6030 high-density polyethylene, is rigid, resistant to heat and chemicals, and far tougher than conventional outer cases made of hard rubber or composition material. The removable frame is secured, top and bottom, by four posts and cradles the cells effectively against shock. It is injection molded in two-cavity combination molds. Shots weigh 7 oz. for a 6-v. frame, 6 oz. for a 12-v. frame.

From all indications, these examples are typical of the extensive plastics redesign being undertaken by many other battery manufacturers. It is known, for instance, that several manufacturers are doing research with the tough, new plastics copolymers and alloys as possible housing materials; and the use of polyethylene as a material for separators is undergoing exhaustive study. While representing only a limited market for plastics, batteries are in the process of adapting the materials as standard and of becoming a product where plastics' superiority is proved.—END

The URETHANES grow up—Part 2

No matter what your business, these versatile foams may fit into the picture. Here's what some companies have done—and why

TURBINE BLADES (see close-up in lower photo) in Boeing supersonic wind tunnel, with RP shells and cores of foamed-in-place rigid urethane supplied by American Latex, are lighter, safer, and longer lasting than metal blades.

The unusual combination of physical properties inherent in urethane foams, coupled with the variety of methods available for processing them, have endowed these materials with unique versatility. Although originally thought of as competition for rubber foam in the lush cushioning market (see last month's article), urethanes have already branched out into a number of specialized applications which, taken together, may eventually equal, or even surpass, the large volume of foam being earmarked for the furniture cushioning field.

Essentially, the applications fall into one of these four categories: thermal insulation, structural uses, packaging, and consumer products. Within each of the categories, there is again a wide range of end uses touching upon many industries. What these uses are and how they have determined the structure of the urethane industry is the subject of this second of three articles.

Thermal insulation

Rigid urethane foam (polyether-, polyester-, and even castor-oil-based) is gaining wide acceptance as an insulating material in industrial and domestic applications. Standard formulations have a K factor of about 0.22, which is about the same as fibrous glass, but about twice as good as cork. (K factor is a measure of insulating efficiency—the lower its value, the bet-

SELF-INSULATED pipe for heating or cooling cars in drive-in movie theaters has wall made of flexible urethane foam covered with heat-sealed polyethylene film and reinforced with wire spiral (inset) to increase structural strength. Pipe was developed by Standard Plastics, Inc., Fogelsville, Pa., using prepolymer from Isocyanate Products, Inc., Wilmington, Del. Pipe outlets which extend into car are molded from same prepolymer.

ter the insulation.) Recently the Frigidaire Div. of General Motors discovered a method of foaming urethane with fluorinated hydrocarbons, better known by the tradenames Freon (Du Pont), Genetron (Allied), Ucon (Union Carbide), and Isotron (Pennsalt). This heavy gas is trapped in the millions of tiny urethane cells and, because of its low thermal conductivity, reduces the K factor to about 0.14 for a 2 lb./cu. ft. density of rigid foam. In practice this means that about 40% less foam insulation is required in any one application, resulting in larger storage space in refrigerators, without increasing the outside dimensions. The same properties have also led to the adoption of urethane foam in milk coolers, storage tanks, refrigerator tank cars, ice cream cabinet lids, and similar applications.

Another interesting application is pipe insulation, which can be sprayed-on or molded, using rigid, semi-rigid, or flexible foam. Growth for this market depends largely on specialized distributors and suppliers, and on the training of fitters.

For most thermal insulating applications urethane is foamed in place from prepared liquids, thereby reducing assembly time. In addition, the reaction process as the foam expands to fill cavities imparts excellent adhesive bonding characteristics which produce a strong laminate. Urethane foam also has a high strength-to-weight ratio, which makes it possible to use lighter materials for the outer shells of appliances, for example. These properties are also of importance for structural uses.

For high temperature resistance (which is required for missile applications, for instance) PAPI polymethylene polyphenyl isocyanates, produced by The Carwin Co., North Haven, Conn., can be used as a basic ingredient for the manufacture of rigid foam. When combined with conventional polyesters, this specialty isocyanate produces foams which withstand temperatures up to 600° F., while maintaining 70% of the strength and integrity of the foams at room temperature. Special polyols can bring this temperature resistance up to 900° F. Properly cured urethane foams based on conventional isocyanates, as supplied by Mobay, Allied, and Du Pont, are dimensionally stable and perform effectively at intermittent temperatures of 300° F.

Flexible urethane foam is used as lightweight insulation for garments. The Foam Div. of Scott Paper Co. has developed a 100% open-celled polyester foam for interlining, which drapes well, does not bunch, and is unaffected by perspiration. New laminating techniques now make it possible to use open mesh knitted goods for outer shells. Future uses may include a sandwich construction—outer shell, interlining, and lining—which can save manufacturing costs. The interlining market is expected to grow from about 500,000 lb. in 1958, to 4 million lb. in 1963. For this application, foam $\frac{3}{32}$-in. thick and 45-in. wide is commonly used and is distributed through textile jobbers.

Structural uses

The light weight of urethane foam, in combination with its other properties, fits in well with current trends in the building industry which call for more pre-fabricated units and for more flexibility of arrangement of space, which is frequently accomplished by using curtain walls and other panels.

In general, curtain walls are not used for support, but for insulation, although here

again the foam core lends structural strength to lightweight panels. Furthermore, urethane foams have excellent sound-deadening and vibration dampening properties. The use of Hooker's Hetron polyesters also provides the additional advantage of flame resistance, which is always somewhat of a stumbling block for building code approval. There is some feeling that flame tests are not quite realistic, but since a structural foam core must also remain rigid during a fire to prevent collapse of a panel, the high heat resistance which can be obtained in urethane foams is of great importance. In conventional urethanes, additives are used to provide flame resistance, but Thiokol Chemical Corp. is trying to build this property into the molecule to eliminate the possibility of migration, whereby fire at one end of a foam panel may evaporate the additive at the other end.

Although foaming-in-place or spraying over an inflated, reusable form to provide a dome-type structure may provide labor savings, panels appear to have a bigger future in the building industry. Allied Chemical has developed formulations for continuous rigid foam slabstock production, based on the company's isocyanates and polyesters, to meet this need. Dayton Rubber Co. has also just developed a panel with urethane foam backing up a thin brick veneer. Polyesters, polyethers, and castor oil will all share in the market for structural uses of urethane.

An interesting use for rigid urethane foam is a temporary military housing which serves as an electronic equipment shelter. The unit, made of aluminum sheets with a foam core, is manufactured by Craig Systems, Inc., Lawrence, Mass. It weighs 350 lb., holds 2500 lb. of electronic equipment, and can be air-lifted or sling-carried by helicopter. (For details on economics and future uses see MPL, December 1958, p. 91, "Rigid plastics foams in building.")

Since rigid foam can be easily fabricated with saws and other conventional equipment, it would appear to be a natural product for do-it-yourself structural uses, where a slab of urethane foam is nailed or glued to thin veneers —such as plywood—to provide structural strength and insulation. Uses would not be confined to building panels, but could also include ceiling tiles, roof insulation, doors, etc.

Packaging

The varying compression-deflection characteristics which can be formulated in polyester and polyether foams, make urethanes a very versatile packaging material. At the moment, most applications are in the military and electronics equipment fields, where the object which is to be protected is frequently encased in a polyethylene bag and urethane is foamed around it. In effect, the electronics part, for example, is its own mold. For some applications, elaborate molds made of relatively inexpensive materials such as wood, are used to produce contours that will cradle the objects. When coated with a release agent, these molds are ready for reuse within a very short time, when

COMBINATION checking fixture and protective package for solid fuel rocket engine is molded of rigid urethane foam material supplied by Dayton Rubber Co.

INEXPENSIVE MOLD for fixture-package shown in photo at left is made up of dowels and simple wood patterns. Mold surface is coated with a thin film of silicone-based parting agent before urethane mix is poured. Foam sets in a few seconds, after which the mold is ready for immediate reuse.

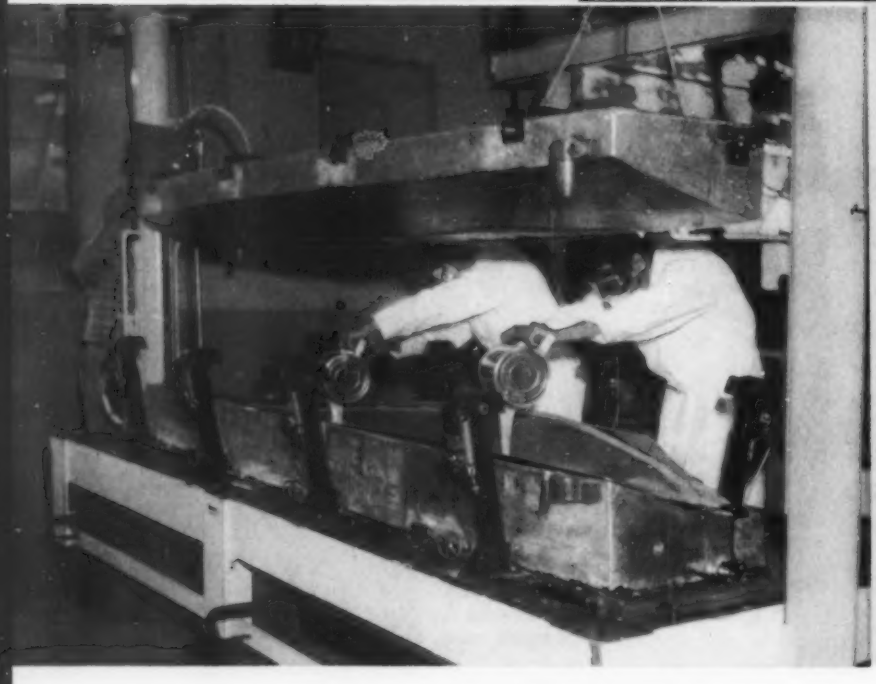
the foam has cured. Standard Plastics, Inc., Fogelsville, Pa., is a company that has concentrated on molded rigid, semi-rigid, and flexible packaging, while Shelley Foam, Los Angeles, Calif., maintains extensive fabricating facilities to engineer consumer and industrial packages in a wide variety. The high load-bearing capacity of urethanes is exemplified by a protective packaging application developed by Thiokol, where less than 6 in. of rigid foam supports an 8-ft. metal cylinder, having a diameter of 3 ft. and weighing more than a ton, resulting in significant savings in freight costs and storage space. Other important properties provided by urethane for packaging applications include slip-proof characteristics and thermal stability.

Although the cost per board foot of urethane foams is high compared with such packaging materials as curled hair, wadding, paper, etc., economic advantages are being obtained by ingenious use of all the properties of these foams. The versatile fabricating methods, which include die-cutting, laminating, spraying, wrapping, and foaming-in-place, make it possible to engineer packages to provide maximum protection with the minimum in weight and volume. Consequently, fabricating distributors with imagination and some technical knowledge of the packaging field can find volume markets which have not been tapped in many areas of the country.

Consumer products

The trend toward larger carpeted areas and wall-to-wall covering encourages the use of underlayment, for which thin sheets of flexible urethane are particularly suitable, because they provide cushioning, are non-skidding and, since properly formulated foam does not mat down, it imparts a luxurious feel even to less

DESTRUCTIVE VIBRATION is damped in aircraft fairing section (shown in close-up at right) by rigid urethane foam molded to metal part. Fairing has a maximum thickness of about 1 in., decreases uniformly to a feathered edge. →



AIRCRAFT FAIRING with foam surface is produced in mold set-up shown at left. Hand-mixed American Latex formulation is poured into heated mold, which is then clamped shut. Foam fills cavity in 15 sec., is cured for 3 hr. to obtain maximum properties. Material has 5 lb./cu.ft. density.

costly carpeting. This market is expected to grow from a little over 1 million lb. used in 1958 to 3 million lb. in 1963. However, if a material can be produced that sells for around 80¢/sq. yd. to distributors, instead of the present price of $1.25 to $1.50, the potential might be two to three times greater.

An interesting specialty product developed by Scott Paper Co. consists of a coarse open-cell foam, similar to curled hair in texture and having between 10 and 30 cells per linear inch, which is used as a washable filtering material for air conditioners, ventilating equipment, etc. The open cell structure of the foam, the material's ability to provide air filtration without moisture absorption, and the possibility of eliminating frames, are of special advantage.

Polyester-based flexible foam is widely used for household products which were the first markets for urethanes in this country. Paramount Foam Industries, Ridgefield, N. J., continues to produce specialty formulations and a wide variety of colors, which are required for such applications as ironing board pads; dish mops; clothes brushes; squeegees; etc. Toys and novelty items are also mainly markets for polyester, and Thiokol has developed two types of hydrophilic polyesters which can be used for toys that swell in water.

Elkins-Ewall, Philadelphia, Pa., and Medical Fabrics Co., Inc., Paterson, N. J., have introduced foam strips for medical applications as non-binding, non-allergenic, sterilizable bandages, which also take advantage of urethane's X-ray permeability and self-ventilating characteristics. Another versatile product is urethane foam laminated to pressure-sensitive tape (manufactured by Air-Plastik Corp., Union City, N. J., and also imported from Germany by United Mineral Chemical Corp., New York, N. Y.) which is being used as a sealing strip or as an assembly belt.

The structure of the industry

The diversity of applications and the broad range of markets for urethane foams has resulted in special production and (*To page* 200)

AIRCRAFT RESEARCH models (see photo at bottom of page) are produced in a split epoxy mold which is first coated with a wax mold release, then lined with a layer of fibrous glass which has been impregnated with epoxy resin.

MODEL MOLD half receives urethane charge, is then closed and clamped. Foam completely fills the entire cavity and cures in one hour.

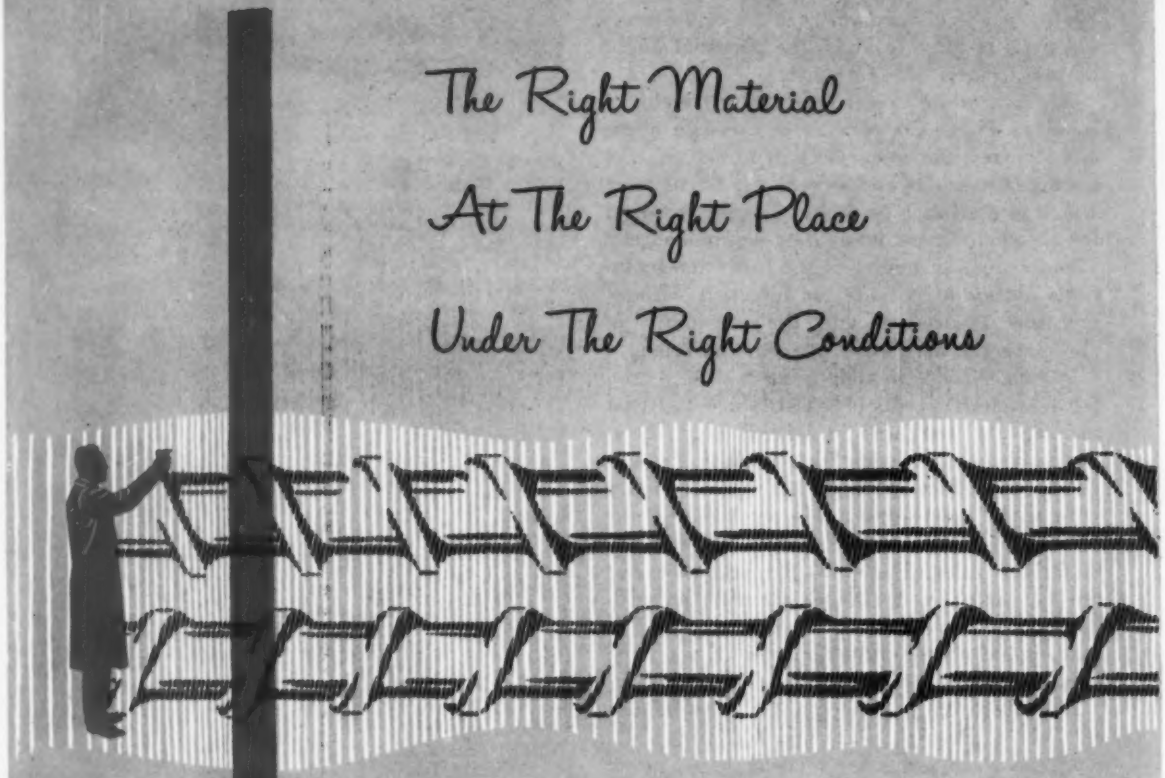
WIND TUNNEL models of droppable fuel tanks and pilot escape capsules have urethane cores for light weight and strength, glass-epoxy skins for minimum wind resistance. Made by Chance Vought Aircraft, Inc., using urethane ingredients supplied by Minnesota Mining & Mfg. Co., and Emerson & Cuming, Inc.

The WEI Dual Worm Compounder-Devolatilizer-Extruder Chain-of-Command:

The Right Material

At The Right Place

Under The Right Conditions



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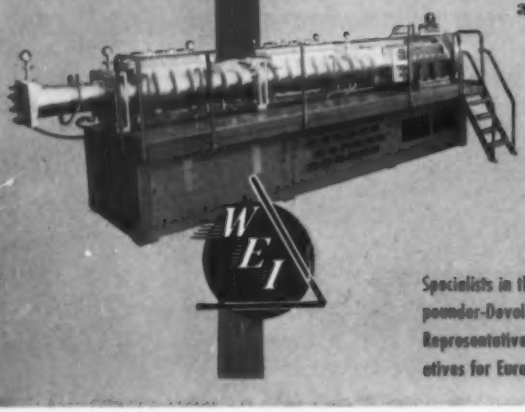

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Working with polycarbonate resin

Practical operating data on injection molding, extruding, machining, finishing, and bonding of this new thermoplastic

By E. F. Fiedler†, W. F. Christopher†, and T. R. Calkins†

During the short time that Lexan polycarbonate (PC) resin has been commercially available, its interesting combination of toughness, heat resistance, dimensional stability, and good electrical properties (1)[1] has aroused much interest in its processing and fabrication. This article summarizes our present knowledge of these operations with PC.

Keep it dry!

As every molder of nylon and cellulosics knows, even a small percentage of water in the molding powder can cause troubles in molding—frothing, bubbles, splay marks, and even reduction of physical properties. PC, too, must be kept dry before and during molding, since it will absorb moisture from normal plant atmospheres. To this end it is shipped dry in sealed 25-lb. tins. The best handling procedure in the molding or extrusion plant is as follows: Heat the unopened can and its contents to 250° F., pour the hot pellets into the machine hopper, and keep the air over the pellets at 250° F. with a hopper drier, preferably one of the dehumidifying type. Circulating air through the pellets at some temperature less than 250° F. is more likely to increase the water absorption than it is to reduce it (2).

Where this procedure can't be followed, the following precautions are helpful: 1) never open a can that has just been taken from a cold storage area; 2) if powder is fed at room temperature, keep it out of contact with room air—either use a dehumidifying-type hopper drier or simply cover the machine hopper.

Molding powder that has been exposed to moisture, and all reground material, must be redried. This can be accomplished by spreading the pellets in trays to a depth of 1 in. or less and heating them at 230° F. for at least four hours in a dehumidifying oven, or at 260° F. in an oven that is not equipped with a dehumidifier. Since PC pellets tend to pick up dust by static electricity, trays should be carefully cleaned before they are loaded.

Flow characteristics

Polyaryl carbonate is relatively viscous in the molding temperature range. In Fig. 1, p. 116, are log-log plots of apparent shear rate vs. shear stress at four temperatures for PC resin. These plots are based on smoothed data from a Caplastometer (3), an extrusion-type rheometer fitted, in this case, with an orifice 0.0708 in. in diameter and 0.500 in. long. The same data are presented as apparent viscosity vs. shear stress plots in Fig. 2, p. 117. (Apparent viscosity is defined as the quotient of the shear stress at the orifice wall, $pR/2L$, divided by the apparent shear rate at the wall, $4Q/\pi R^3$, where R and L are the orifice radius and length, p is the pressure drop, and Q is the volume rate of flow.) The 95% confidence limits for these viscosity graphs are approximately ±20%, the exact percentage being somewhat lower at high viscosities, higher at low viscosities.

The fact that the log-log plots are straight lines over this range of stress and temperature means that shear rate and shear stress for PC are related by an equation of the form: shear rate = (shear stress)^n, where n is the mean slope of the lines of Fig. 1. For these data the value of n is 1.4, and it is unlikely that the true value is lower than 1.31 or higher than 1.46. By comparison, the slope for polystyrene, whose flow

*Reg. U. S. Pat. Off.
†Chemical Materials Dept., General Electric Co., Pittsfield, Mass.
[1] Numbers in parentheses link to references on p. 121.

is much more pressure-sensitive, is 2.7. This means that, in filling difficult molds, raising the injection pressure will not help as much with PC as with polystyrene.

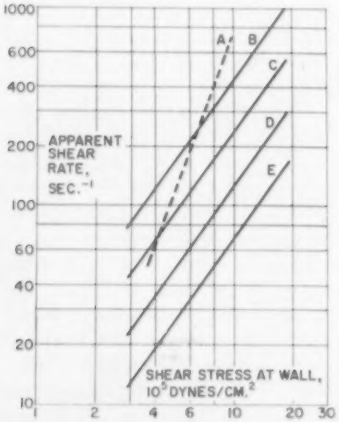
The sensitivity of flow to changes in melt temperature is another important factor in processing. In this respect PC is again on the low side, with an "activation energy of flow" of about 14 kilocalories. In practical terms, as Fig. 1 shows, this means that the flow rate just about doubles with each 50° F. rise in melt temperature. Of course, flow into a chilled mold won't be nearly this sensitive to melt temperature, as Griffiths' work (4) shows, because loss of heat to the metal mold so drastically curtails flow.

Two figures are available on the melt density of PC resin, whose room temperature density is 1.20 gm./cc.: 0.933 gm./cc. at 250° C. and 0.882 gm./cc. at 316° C.

INJECTION MOLDING

Polycarbonate resin has been successfully molded in molds that were designed for nylon, acrylic, polystyrene, cellulosics, and others. However, consideration must be given to differences in mold shrinkage and flow characteristics between PC and other resins. The following mold characteristics are helpful in obtaining best results.

FIG. 1: Flow characteristics of polycarbonate and polystyrene resins. **A:** polystyrene at 440° F.; **B, C, D, E,** PC resin at 650, 600, 550, and 500° F., respectively.



1) *Heated molds.* While some parts can be molded satisfactorily in room-temperature molds, heated molds usually give best results. For most parts, mold temperatures of 175 to 200° F. give good results. Both front and rear parts of the mold should be heated. Molds having large areas, thin sections, or complex shapes, or multiple-cavity molds having long runners may require higher mold temperatures. Some molds have filled best at temperatures of 230 to 250° F. Coring designed to keep the runners as hot as possible has been found beneficial in molding PC. Parts molded of polycarbonate will eject from the mold at temperatures up to 250° F., or even higher for thin-walled parts.

2) *Sprues and runners.* Sprues of standard design perform satisfactorily. For improved flow, however, an extended nozzle with heater band used in conjunction with a short sprue bushing is suggested. An adequate cold-slug well should be provided, though cold slug can be minimized by use of a heated nozzle with cut off. Large-diameter runners, full-round and as short as possible, with a minimum number of right-angle turns, are recommended.

3) *Gating.* Full-round, large-diameter gates give good results, as do large rectangular gates also. Gate lands should be as short as possible. Tab gating gives good results and sometimes helps overcome splay when gating into large sections. The gate to the tab should be large. Fan or fish-tail type gates also give good results.

4) *Inserts.* PC molds well around inserts and because of its unusual toughness, holds inserts firmly. It is necessary, however, that sufficient plastic be molded around the insert to distribute the strain set up in the material by the differential thermal shrinkage of the metal and the plastic.

5) *Mold shrinkage.* Mold shrinkage of PC is 5 to 7 mils/in. and is predictable to rather close tolerances. Shrinkage is about the same both in the direction of flow and across the direction of flow. Molds should be designed to 6 mils/in. shrinkage. Post-molding shrinkage has not been observed in PC parts. Cycle, as it affects "packing" in the mold, can influence dimensions slightly.

6) *Mold lubrication.* For mold lubrication, an occasional light dusting with zinc stearate is suggested. Silicone spray is also effective as a lubricant but may result in poor surface finish of the part. Minimum use of lubricant is desirable and any tendency of parts to stick in the mold may better be eliminated by appropriate adjustment of temperatures, pressure, or cycle, or in some cases by polishing the mold.

7) *Mold surface.* Either polished-steel or chrome-plated surfaces give excellent reproduction.

Molding temperature

PC resin has a broad plastic range and good thermal stability at usual molding temperatures—from 525 to 625° F. Where adequate mold heat is available, few parts require cylinder temperatures above 600° F. A heated nozzle usually improves moldability and surface finish.

Cylinder temperatures. Best results are usually obtained by keeping the rear cylinder temperatures higher than the front cylinder temperatures. On machines having three heating zones the following conditions are typical:

Rear	*Middle*	*Front*
°F.	°F.	°F.
600	575	575
575	575	550

On machines having two heating zones, the following conditions are typical:

Rear	*Front*
°F.	°F.
600	575
575	550

Nozzle temperatures. A heated nozzle is desirable when molding PC, and the nozzle temperature should be equal to the front cylinder temperature for best results. If drooling occurs, nozzle temperature may be lowered. On machines not having a separate nozzle-heat control, good results have been obtained by controlling the nozzle-heater band with

the front-cylinder-zone thermocouple. Nozzles equipped with automatic cut-off have been run at temperatures above the front cylinder temperature with good results.

Overheating. PC resin shows outstanding resistance to thermal degradation. However, overheating can result from excessive dwell time in the cylinder at high temperatures. Excessive color change to dark yellow may indicate that the cylinder temperature is too high or that the nozzle temperature is too high if it is higher than the front cylinder. When darkening or color change is found in molded parts, such parts should be tested for toughness. If they show any brittleness, this is an indication that degradation has occurred. Such parts should be scrapped and the cylinder purged. Resin that has picked up moisture can be degraded at temperatures and dwell times that would leave well-dried resin unaffected. So an apparent problem of overheating may be a problem of moisture-pick-up.

Nozzles

The conventional injection nozzle with tapered bore can be used for molding PC, but is less satisfactory than some of the newer types of nozzles. Also, it is frequently difficult to fit a heater band to injection nozzles of this type. Because of the high melt viscosity of PC, a nozzle design that will offer minimum resistance to plastic flow and transmit maximum pressure to the mold cavity gives best results.

A nozzle with a constant-diameter bore, a rather sharp radius to the orifice, and short land is recommended. A reverse taper on the land facilitates sprue removal. This recommended nozzle can be easily heated, and extended nozzles of this type can be used with molds designed with short sprue bushings to increase plastic flow. Nozzles with screens should not be used.

To eliminate drooling of PC at high nozzle temperatures, nozzles equipped with an automatic cut-off device have been found helpful. At normal molding temperatures, drooling is not a problem with PC and, should it occur, can generally be controlled by dropping the nozzle temperature 10 to 25° F. Should drooling continue, the problem may be one of moisture pick-up resulting in degradation of the resin, and parts should be tested for toughness.

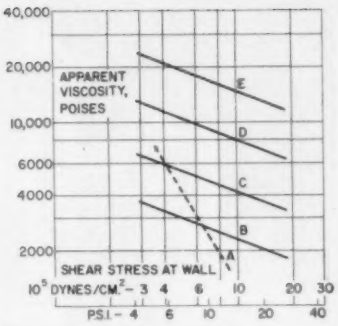


FIG. 2: Viscosity vs. shear stress for polystyrene and PC resin at same temperatures as in Fig. 1. Injection molding stress range is higher than shown here—about 100 p.s.i. At such stresses, the more pressure-sensitive PS will be much less viscous at 440° F. than is polycarbonate at 650° F.

Before molding PC, the cylinder should be thoroughly purged. A purge with crystal polystyrene followed by a PC purge is recommended as both an economical and efficient procedure. It is suggested that nylon resins not be purged directly with PC. After molding with PC, an immediate purge with crystal polystyrene is suggested if the machine is next to be used for molding a material other than PC. Occasional purging is recommended after shutdown while the cylinder is cooling, particularly after operating at high cylinder and nozzle temperatures.

Cycle

As with other resins, optimum cycle requires a quick fill, hold time just adequate to allow gates to freeze, and a short setting period. For most molded parts, the highest possible ram speed has been found desirable, for thick as well as for thin sections.

Here are some typical cases. The radio case halves shown in Fig. 3, p. 120, the two-cavity mold which was designed for polystyrene, had a shot weight of 4.80 oz. at a mold temperature of 180° F. The cycle broke down as follows: ram travel, 7 sec.; ram hold, 15 sec.; setting time, 10 seconds. The thin coil forms shown in Fig. 4, p. 121, were molded on a 13-sec. cycle consisting of 3 sec. for ram travel, 4 sec. hold time, and 6 sec. setting time. Shot weight was 0.78 oz.; mold temperature 210° F. High ram pressures are best for molding PC resin, 15,000 to 20,000 p.s.i. being typical.

Relieving stresses

PC moldings, like those of other thermoplastics, show varying degrees of molded-in stress, depending on molding conditions. Molding at the conditions recommended above will usually keep the stresses down to the level at which performance of the parts is not adversely affected. However, if internal stresses are too high for the application, they may be partially relieved in parts less than ⅛ in. thick by heating them overnight in an oven at 250 to 275° F. For thicker sections, annealing for at least 24 hr. is suggested. Caution: heating above 275° F. may cause distortion and shrinkage.

EXTRUSION

Polycarbonate resin presents no serious problems in screw extrusion. Its low flow-sensitivity to pressure-difference and temperature make it better behaved, from the extrusion standpoint, than many other resins whose working temperature ranges are narrower, or whose flow is more sharply affected by changes in temperature and back-pressure in the extruder.

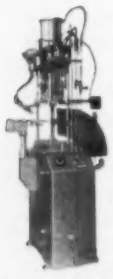
The same precautions concerning moisture must be observed in extruding this resin as in injection-molding it—minimum exposure to room air, preheating cans before opening them, and using a dehumidifying hopper-drier if it is available.

On the basis of experience to date, all conventional screw designs seem to perform equally well with PC, delivering about the same quantity and uniformity of output. Bridging of the feed occasionally occurs and may be avoided by starve-feeding the screw during start-up until extrudate begins to appear, then filling the *(To page 120)*

Mr. R. W. Van Riper, Jr., Vice President of T. F. Butterfield, Inc., makes a quality control check on the output of one of the 6 Stokes Model 741's installed in their Naugatuck, Connecticut plant. Truly automatic operation by these presses has substantially benefited this custom molding operation.

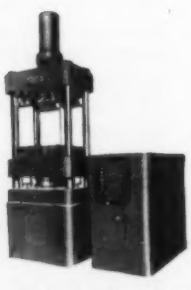
OTHER STOKES PRESSES FOR THERMOSET MOLDING

The Stokes Model 800 automatic . . . 15 and 25 ton models. Has all the advanced features of the larger Model 741's.



The Stokes Model 725 automatic . . . 25-ton capacity. A simple low cost machine for varying production runs.

The Stokes Model 726 semi-automatic compression molding press. 50, 100, 200 and 300 ton models.



The Stokes Model 727 semi-automatic transfer molding press. 50, 100, 200 and 300 ton models.

Some of the many small electric switch parts being made on Stokes Model 741 presses at T. F. Butterfield, Inc.

"Production rate doubled—product improved" —when Butterfield installed Stokes presses

T. F. Butterfield, Inc., Naugatuck, Connecticut, is a custom molder—operates over 60 molding presses. The six most recently acquired compression molding machines are Stokes Model 741's, which were chosen by Mr. Butterfield and an evaluation committee after careful comparison of several types.

These Stokes presses are used for molding plastic parts, such as switch and electrical device parts, of phenolic, urea, and melamine. One man easily monitors the six presses, resulting in a substantial savings in man-hours. Other benefits attributed to the Stokes presses include "improved product quality —greater product uniformity—increased production —fewer rejects".

According to Mr. R. W. Van Riper, Jr., Vice President of the company, these presses are producing at rates up to 1440 pieces per hour—double the previous production. Designed for continuous operation, these presses require very little standard maintenance. The ease of set-up and mold change-over cuts down-time to a minimum.

For your own molding operations, it will pay you to check the advanced features of the Stokes 741's that bring you fully automatic compression molding in its most fool-proof, most productive form. Twenty-five years of leadership in automatic molding is built into these presses:

Positive ejection, top and bottom . . . parts are mechanically combed off ejector pins on both top and bottom ejection.

Parts can't fall back into molds . . . feed and comb form a box closed front and back. Scrape-off discharges parts independent of gravity.

Simplified set-up . . . feed changeovers made in five minutes from pre-set loading boards . . . no cups to shift or adjust each time.

Faster cycles, higher output . . . dry cycle time is only 8 seconds. Fast closing and pressing speeds let you take full advantage of fast curing compounds.

Tops in versatility . . . Hydraulic top and bottom ejectors and fully adjustable breath controls are standard. Side draw . . . integral powder pre-heat . . . automatic rope pre-mix feed . . . fully automatic transfer are available to suit the job.

Press capacities of 50, 75, 125 and 200 tons are available. Write today for a copy of our new bulletin on the Model 741—for a consultation on your own requirements—or for a cost study on your own specific applications.

Plastics Equipment Division
F. J. STOKES CORPORATION
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STOKES

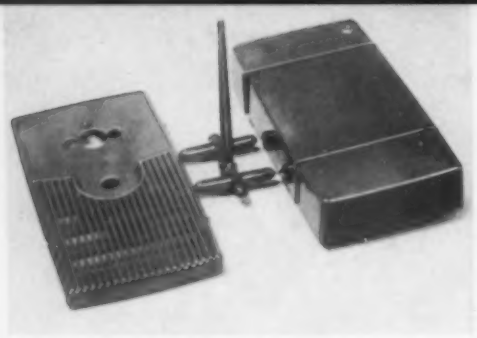

FIG. 3: Two halves of miniature radio case were molded in 8 oz. Reed at following cylinder temperatures: rear, 625° F.; middle, 615° F.; front, 600° F.; nozzle, slightly below 600° F. Ram pressure was 18,000 p.s.i.

feed hopper. Vented cylinders are not necessary.

Because PC remains relatively viscous at high temperatures and high extruder-head pressures, pressure back-flow is apt to be lower, and output higher than usual for a given screw speed. High screw speeds may develop excessive pressures and overload the motor, especially if melt temperatures are low. Normal operating pressures range from 500 to 3000 p.s.i., depending on the product and die geometry.

Barrel temperatures in the range 525 to 575° F. are satisfactory. Temperature profile is usually uniform, although the die may be run up to 20° hotter than the cylinder and the feed zone as low as 20 to 50° F. cooler. Neither the screw nor the feed throat need be closed. However, where viscous working is heavy, the barrel may have to be cooled.

PC extrudates may be cooled with air or water, depending on their shapes. As with other thermoplastics, too rapid cooling of thick sections may cause internal voids due to shrinkage.

Either blown or flat film can be made from PC. However, it may be difficult to collapse and wind a blown tube without wrinkling it, so blown-film extrusion is not now recommended. Draw ratio should be about 2 to 2.5 for films thicker than 10 mils. For thicknesses under 10 mils, a die-lip opening of 20 to 25 mils is suggested, with appropriate drawdown. It is recommended that flat film be extruded directly onto take-up rolls held at some temperature between 200 and 250° F.

FABRICATING AND FINISHING

Polycarbonate resin can be machined very easily using standard metal-working tools. Since PC is tough and high-melting, it has little tendency to soften and gum during machining.

Drilling and tapping. Standard drills—118° point angle, 5° rake, etc.—may be used for drilling PC. For ¼-in. or larger, a drill speed of 300 r.p.m. is recommended, while for smaller drills as high as 800 r.p.m. is permissible. Very clean holes are obtained without gumming, even without air or liquid cooling. There is no tendency for the drill to break out of the bottoms of holes or to chip the edge of the hole, even when the drill is forced. Holes may be enlarged with larger drills with no hogging or chipping.

The same recommendations apply to tap drills. Tapping is done with standard steel-working taps. A 100% thread utilization is permissible, though the resin offers considerable resistance to the tap. Neither reduction of thread utilization to 50% nor use of kerosene lubricant appears to lessen this resistance. Tapped threads have high torque resistance. For example, a ½ = 13 bolt, penetrating a block of PC to a depth of 9/16 in., required a torque of 48 ft.-lb. to strip the threads. There was no cracking or crazing around the hole. In another test, a 3/16 = 24 bolt penetrating 9/16 in. required 50 ft.-lb. to *twist off the bolt*, leaving the PC threads unmarred.

Sawing. Parts fabricated from PC can be sawed with any type of saw, using regular wood- or metal-cutting blades.

Using a metal-cutting bandsaw with 18 teeth/in., a saw speed of 1500 to 1950 ft./min. is recommended. Below this speed, the cutting action is too slow; but even at 1950 ft./min. there is no sign of gumming. Using a plastics-cutting blade (regular-pitch precision blade, 8 teeth/in.), a very fast feed can be obtained with PC. Again, at a saw speed of 1950 ft./min., no gumming is evident.

Trials with jig and radial saws indicate that no particular difficulties will be encountered in sawing PC with this equipment.

Hand-held hack saws, using regular blades, may also be used to cut PC with very little tendency for the part to break away near the end of the cut.

Turning. Lathe turning, boring, and threading operations may readily be carried out on PC using standard steel-working tools. That is, turning tools should have 0° rake and 3° clearance, while boring, threading, and roughing-out tools should have 5° rake. Positioning of the tool on the work is not critical.

A turning speed of 550 r.p.m. is recommended and the forward progression speed is dependent only upon the smoothness of cut desired. In no boring, turning, or internal threading operation is the use of a coolant necessary. When the tool bite is properly adjusted, the cutting will curl away in a long, opaque spiral, much as with aluminum.

PC resin may readily be turned to a rod diameter of ¼-inch. Below this diameter it has a tendency to whip when supported only on one end. However, rod of this diameter can easily be threaded by machine with a steel-working die, again without the use of lubricants.

Shaping. A shaper, operating at 138 strokes per min. and equipped with a steel-working cutting tool (5° rake), produces excellent cuts on molded PC blocks. Advances of 2, 10, and 70 mils can be used with up to 50 mils depth of cut without any danger of gumming or edge-chipping. No lubricant is needed in this operation.

Milling and routing. The use of high rotating speeds or low feed rates are advisable for end-milling PC. For example, a 100-mil cut with a ¾-in. full-lip end mill turning at 425 r.p.m. caused edge chipping at a feed rate of 30 in./min.; a smooth cut was produced at a 22-in./min. feed rate. The higher rate is permissible if milling speed is 2100 r.p.m. The lower speed (425 r.p.m.) is recom-

mended for side cut or climb milling at a feed rate of 30 in./min. Within these limits, no coolant-lubricant is necessary.

Routing cannot be carried out without a liquid lubricant-coolant. As an example, a ⅛-in. full-fluted routing mill, turning at 425 r.p.m., was used to cut a ¼-in.-deep notch in PC at a feed rate of 5.7 in./min. Without lubricant, the notch was badly gummed. However, with lubricant, only a light feather-edge was obtained which was easily removed when the part was wiped with a cloth.

Punching and shearing. Thin sections of PC can be punched or sheared very easily. For example, an ordinary paper-cutter will perform satisfactorily on thicknesses up to 20 mils. In thick sections—60 mils or greater—the material tends to draw as it shears. There is no cracking or crazing around cut line or hole.

Finishing operations

Filing. A single-hatched file is much better for filing PC than a cross-hatched file, since the latter has a tendency to clog under heavy pressure. A No. 2 pillar file has no tendency to clog with PC when used with light pressure.

Sanding. PC sands readily with either 36-X (coarse) or 80-X (medium) sanding machine belts. A small amount of lap-over cannot be avoided; but there is no tendency for the material to gum even under extra heavy pressure. The sanding belt will fill slowly, and wet sanding conditions do not alter the results.

Hand sanding must be done with light pressure to avoid clogging the paper, especially with the extremely fine grades. For example, 100-grit Carborundum paper works well with light pressure but clogs with heavy pressure; 240-grit paper works well only with very light pressure; while 320-grit paper exhibits slight clogging even with very light pressure but continues to produce a fine satin finish. Crocus cloth also shows a tendency to clog when used on PC resin, but the use of kerosene lubricant prevents this and produces a very fine satin finish.

Buffing. Parts molded of PC have been buffed with regular metal-buffing compound, No. 888 plastics-buffing compound, and wet-ashing (FF pumice) with excellent results. Using the metal-buffing compound, the cutting action is slow and a very high luster is obtained without further action; with the latter two compounds the cutting action is somewhat faster and both require a final dry-buffing operation to produce a lustrous finish.

Bonding and sealing

Cementing of PC resin parts to each other or to another material can readily be accomplished by either solvent cementing or the use of commercially available bonding agents.

Solvent cementing can be carried out using either a pure solvent or a 10% solution of PC in the desired solvent. The solvents generally used are methylene chloride, tetrachloroethane, and ethylene dichloride. The rates of evaporation of these solvents decrease in the order in which they are mentioned, and the selection of the one best suited for a particular operation will depend upon the area to be bonded and the speed with which the treated parts can be assembled. The procedure for solvent cementing is: A) Wipe the areas to be bonded free of any dirt or oil. B) Place a light coat of the solvent or resin solution on the areas. C) Hold the parts together under light pressure until the bond is formed.

Normally, sufficient bond strength is developed immediately when the parts are joined to allow further operations on the part. Maximum bond strength develops after about 24 hours.

"Solventless" adhesive bonding is recommended for bonding PC to other materials. Room-temperature-curing adhesives that may be used include styrene-polyesters, polyurethanes, and polysulfide-epoxies. The selection of one will depend upon material to which PC is to be bonded.

One excellent general purpose, but high-temperature-curing, adhesive that develops better bond strengths than the room-temperature-curing types consists of a mixture of 100 parts by weight of Epon 828 (Shell Chemical Co.) and 40 parts by weight of phthalic anhydride. The epoxy resin and phthalic anhydride are mixed together and heated to 280° F. with stirring to form a clear tacky mass which is applied to the areas to be joined in the usual manner. Then, after application of the epoxy-anhydride mixture, the two objects to be bonded must be lightly clamped together and held at 250° F. for 24 hr. to totally cure the adhesive. Should bubbles appear, it is recommended that the part be predried at 250° F. for a few hours.

Heat sealing. The same methods used to heat seal other thermoplastics work with PC if the temperatures used are increased to provide for the higher melting temperature of this resin. For example, PC resin can be welded to itself by means of a hot-air "torch," adjusted to about 600° F. For thick sections, the use of ⅛-in.-diameter PC rod is recommended. It is necessary to predry for a few hours at 250° F. before sealing or welding, the time depending on the thickness of the section. This precaution must be taken to prevent the formation of bubbles in the welded joint. Properly prepared bonds of this type have tensile strengths equal to that of the molded resin.

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3. H. J. Karam, K. J. Cleereman, and J. L. Williams, "The Caplastometer—a new melt viscometer," Modern Plastics *32*, 129 (Mar. 1955).
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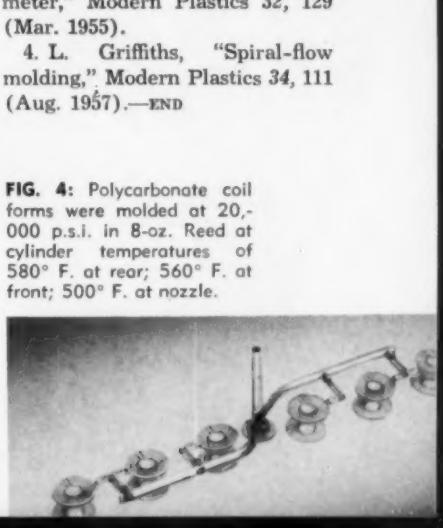
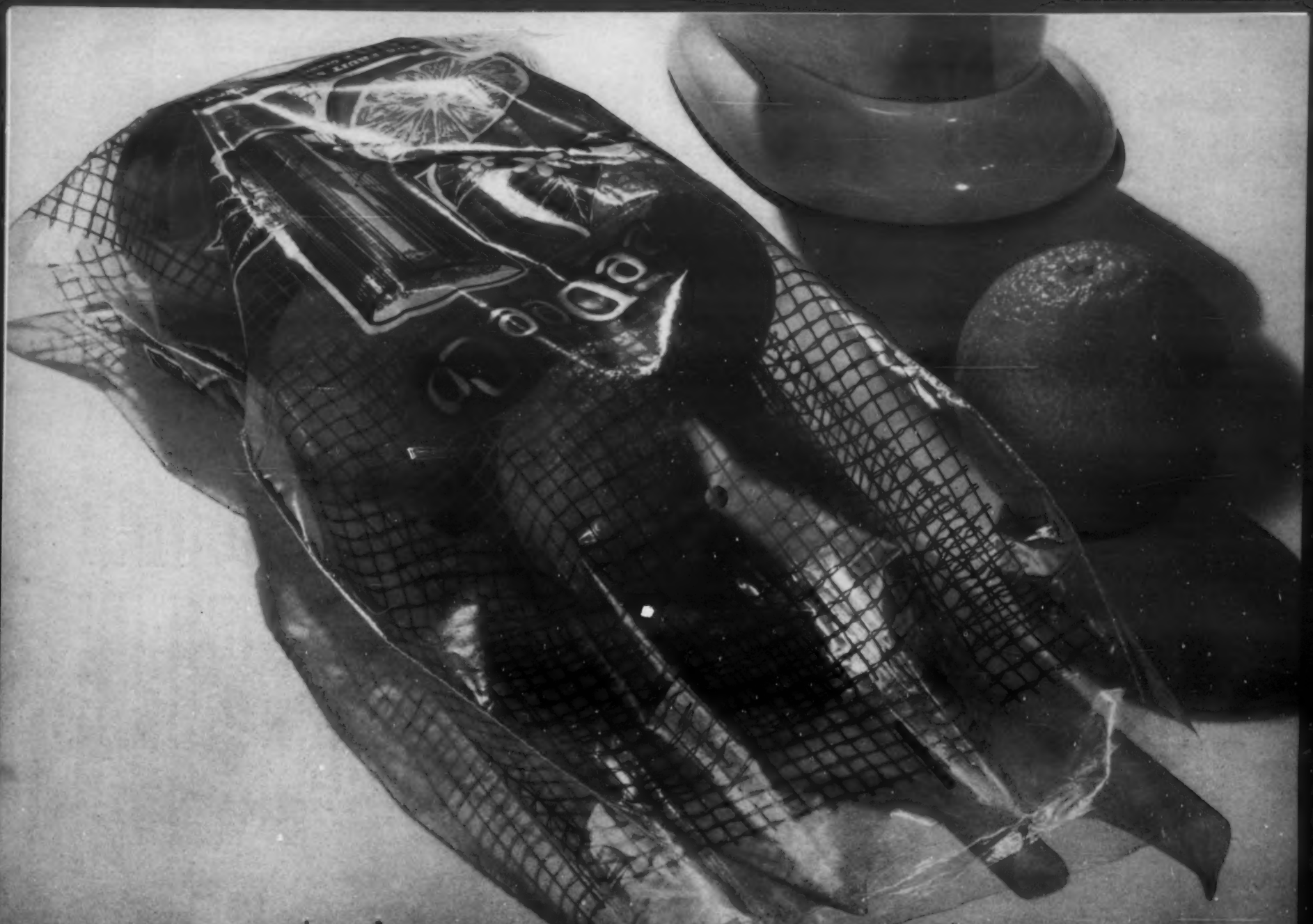
FIG. 4: Polycarbonate coil forms were molded at 20,000 p.s.i. in 8-oz. Reed at cylinder temperatures of 580° F. at rear; 560° F. at front; 500° F. at nozzle.





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Tenite Polyethylene bag extruded, printed and fabricated by Texas Plastics, Inc., Elsa, Texas, for Spada Fruit Sales Agency, Inc., Tampa, Florida, packers of "PeeDeeCo" brand oranges.

The clarity and sparkle of Tenite Polyethylene film enhance the appearance of the product it protects. Food, clothes, hardware, toys . . . look fresher, keep cleaner and sell easier . . . when packaged in film extruded from Tenite Polyethylene plastic.

When used to package oranges, for example, these sparkling bags provide many sales-producing advantages. From packer to purchaser, they display the fruit attractively while protecting against dirt, dust and handling damage. Here, the excellent printability of the film permits full-color reproduction of the old-style mesh bag, a tempting glass of orange juice and the company brand. For packaging other products, the directions for use, product advantages, ingredients or other information can be printed on the film.

While the strength of this Tenite Polyethylene film qualifies it for bagging heavy items such as oranges, its toughness in slightly thicker gauges also makes it a logical material for packaging pointed or sharp-cornered articles such as dime-store quantities of nails, screws, toy blocks and similar products.

In bagging candy, chemicals or baked goods, the moisture resistance of this versatile plastic film means added protection against product deterioration.

Film of Tenite Polyethylene appeals to packaging men who need a material that meets a broad range of specifications. It has excellent resistance to puncture and doesn't tear easily. It has remarkable clarity and gloss. It is tough, inert, waterproof, printable, heat-sealable and . . . economical. Why not let us help you explore the possible usefulness of this versatile plastic in your packaging plans. For more information, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

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How to measure uniformity and predict molding characteristics of polyester premixes

By Allan F. Torres* and Seymour S. Feuer*

Both molders and formulators of polyester premixes can now avail themselves of some long-needed convenient techniques for establishing quality standards and controlling the uniformity of their compounds with a degree of precision not possible heretofore. In addition, they can take useful shortcuts to evaluating the characteristics of new experimental compounds or trouble-shooting unsatisfactory compounds with less dependence on costly trial moldings.

These new procedures are based on the results of two tests recently developed in our Physical Measurement Laboratory. Although many ramifications of the tests are yet to be explored, and additional experience may suggest certain modifications, their usefulness is already evident. While they were developed around Thermaflow glass- or nylon-reinforced polyester molding compounds, the techniques should also be applicable to molding compounds composed of other resins and reinforcing materials.

One test involves the measurement of gel time and exotherm time as a means of establishing standards for the reactivity or "cure" of a molding compound. These reactivity data have been found to correlate closely with optimum curing times in actual test molding cycles and therefore provide a basis for predicting molding times or cycles without actually making test moldings. Furthermore, the times and temperatures observed during the reactivity test permit useful deductions about the characteristics of the catalyst system, etc.

The second test, which involves room-temperature (73° F.) extrusion characteristics, provides a method for measuring product uniformity as indicated by the degree of conformity to the normal average. Abnormal values can reveal non-uniform mixing or wetting of reinforcing fibers, incorrect balance between resin and reinforcement, and deviations in mixing time. This test also provides a method for establishing more precise standards of quality control for production and purchasing of premixes.

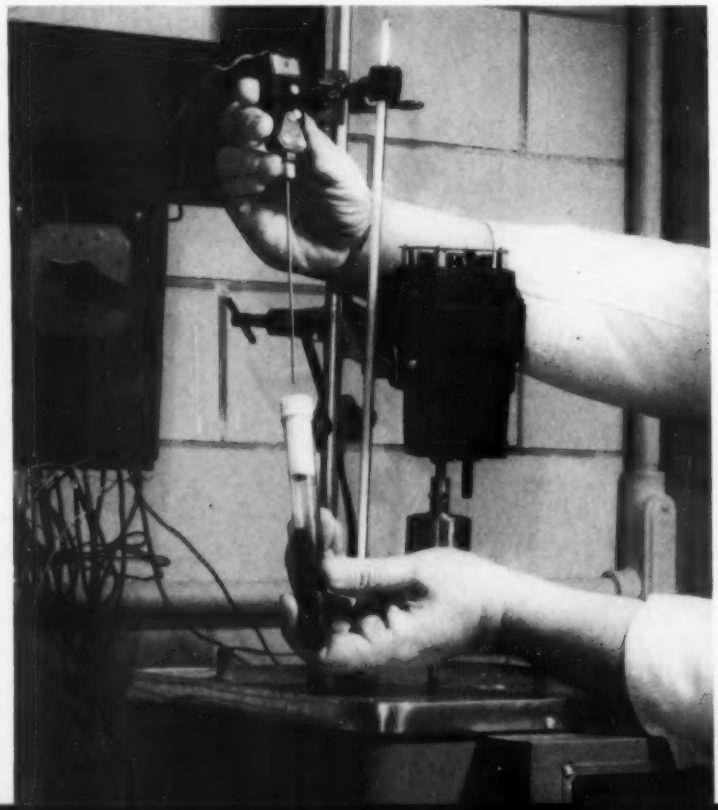
*Atlas Powder Co., Wilmington, Del.

REACTIVITY TEST

The first test makes available a standardized method for evaluating the reactivity characteristics of molding compounds. The apparatus used (Fig. 1, below) is part of the basic equipment of most laboratories. It includes 18- by 155-mm. test tubes; a thermocouple-type temperature recorder having a pen speed of 1 in. per 200 sec.; 1/16 in.-diameter thermocouples in stainless steel jackets; and a mineral oil bath controllable to ± 0.5° C.

Procedure: The sample of molding compound is loaded in the test tube to a height of 3 in. after tamping to eliminate voids. The thermocouple is inserted into the compound and is centered by means of a Teflon plug having a ½-in. by ¾-in. collar resting

FIG. 1: Apparatus used for conducting reactivity tests on premix compounds consists of basic equipment found in most laboratories.



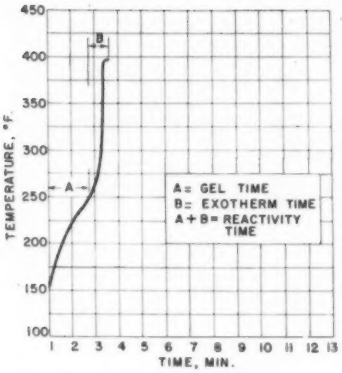


FIG. 2: Typical reactivity curve shows reactivity time in test, which is similar to cure time in actual molding.

on the rim of the test tube. The test tube is immersed in the constant temperature bath to a depth sufficient to cover the sample completely.

For purposes of this test, "reactivity" is defined as the time required for a sample of catalyzed molding compound to rise from a specified base temperature to its peak exotherm temperature. As shown in Fig. 2, above, the reactivity time, similar to "cure time" in actual molding, is actually the sum of two consecutive time intervals. The first interval is the time from the base temperature to the inflection point. This interval is essentially the "gel time." The second interval, therefore, is the time from the inflection point to the peak temperature. This represents exotherm time.

The inflection point is the temperature at which the curing reaction quickens and becomes exothermic, as indicated by a sharp upward deviation from the warm-up curve of an uncatalyzed sample immersed in the same bath. The warm-up curve and inflection point will differ for each bath temperature (or molding temperature) used.

In order to find the bath temperature which would give the most reproducible test system and the greatest correlation with actual molding operations, we tried three different bath temperatures: 300, 250, and 230° F. At each temperature, warm-up curves, shown in Fig. 3, p. 128, were plotted using an uncatalyzed batch of a typical Thermaflow molding compound. At all bath temperatures, the warm-up curves for the uncatalyzed samples were coincident up to 150° F., at which point they deviated. Therefore, 150° F. was chosen as the temperature base line from which the measurement of reactivity time was begun.

The next step was to check catalyzed samples of the same compound at each of the three temperatures. Figure 3 also shows the reactivity curves for this specific material, *(To page 128)*

Table I: Summary of average reactivity data

Thermaflow compound	*Bath temp.*	*150° F. to peak (reactivity time)*	*Inflection pt. to peak (exotherm time)*	*Peak temp.*	*Increase over bath temp.*
	°F.	min.	min.	°F.	°F.
A	300	2.61	0.69 ± 0.10	397 ± 7	97
(Medium range	250	5.07	3.15	341	91
catalyst, minimum	230	7.24	3.91	294	64
inhibitor)					
B	300	3.04	1.12 ± 0.11	401 ± 2	101
(No medium range	250	7.57	5.65	325	75
catalyst, extra	230	13.08	9.75	255	25
inhibitor)					
C	300	3.08	1.16	374	74
(Standard Thermaflow	250	6.09	4.17	334	84
catalyst system)	230	13.43	10.10	262	32
D	300	2.78	.86	361	61
	250	6.54	3.21	323	73
	230	9.25	5.92	258	28
E	300	2.77	.85 ± 0.09	375 ± 7	75
	250	4.42	2.50	334	84
	230	7.40	4.07	264	34
F	300	2.93	1.01 ± 0.13	365 ± 5	65
	250	4.55	2.63	312	62
	230	7.62	4.29	262	32
G	300	3.17	1.25 ± 0.38	334 ± 8	34
(Nylon fiber,	250	4.26	3.34	275	25
high in filler,	230	9.23	5.90	242	12
low in resin)					

Warm-up curves for uncatalyzed samples

Bath temp.	*Time from 150° F. to inflection Temp. of catalyzed sample*		*Time from 150° to bath temp. F.*
°F.	°F.	min.	min.
300	(248)	1.92	11.1
250	(223)	1.92	5.7
230	(221)	3.33	4.62

With the exception of Compound G, all materials tested contained approximately 30% glass, 30% resin, and 40% filler.

Table II: Reactivity of compound C with different catalyst systems

Bath temp.	*150°F. to peak*			*Inflection to peak*			*Peak temp.*			*Incr. over bath temp.*		
%	Min.			Min.			°F.			°F.		
	a	*b*	*c*	*a*	*b*	*c*	*a*	*b*	*c*	*a*	*b*	*c*
300	3.08	3.24	3.37	1.16	1.38	1.67	374	392	390	74	92	90
250	6.09	12.12	13.35	4.17	10.26	11.56	334	312	280	84	62	30
230	13.43	18.90	28.90	10.10	15.30	25.40	262	240	240	32	10	10

Catalyst Code: (a) Standard catalyst. (b) 1% dicumyl peroxide (Dicup). (c) 1% Dicup, 0.1% benzoyl peroxide (BPO), 0.012 % ditertiarybutyl hydroquinone (DTBHQ).

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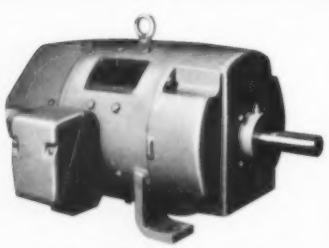

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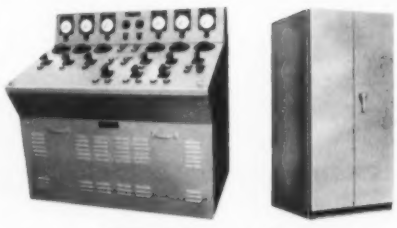

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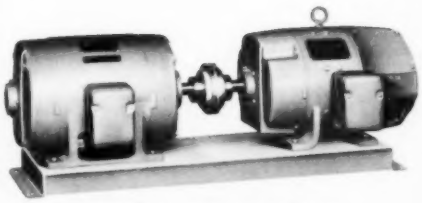

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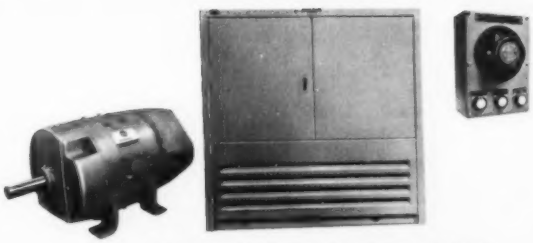

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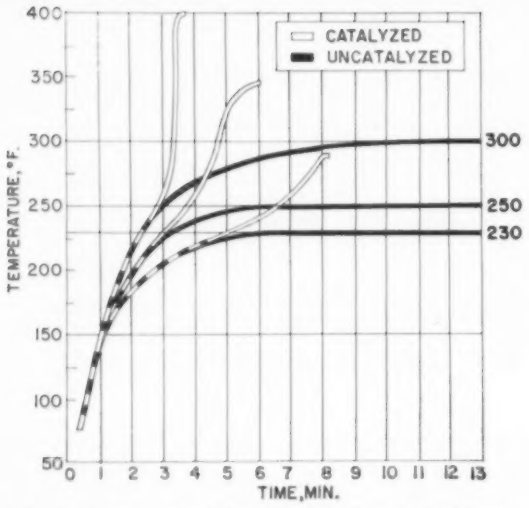


FIG. 3: Curves plotted for uncatalyzed and catalyzed batches of same premix compound when heated to three different temperatures. Data are summarized in Table I.

but is typical of curves charted on other materials. In the 300° F. bath, temperature curve of catalyzed sample deviated from the warm-up curve at 248° F. The time interval for the temperature rise from 150 to 248° F. is defined as the gel time, and the time from 248° F. to the peak temperature is the exotherm time. The "reactivity time" is then the sum of these two times, i.e., the total time interval from 150° F. to peak temperature.

Test results

The reactivity data obtained on seven different Thermaflow compounds, at the three bath temperatures, are summarized in Table I, p. 125. The plus-and-minus limits on the exotherm times and peak temperatures listed for 300° F. are 95% confidence limits and are based on the combined results of three test samples taken from each of three different batches of the compound, i.e., nine tests in all for each compound. The results illustrate how the reactivity time of a given compound is affected by the bath (or mold) temperature and how the reactivity times of different compounds compare at the same temperature. In the 300° F. bath the inflection-to-peak time (280° F. to peak) for the various compounds is very short, ranging from 0.69 to 1.25 minutes. The different time intervals reflect the differences in composition among the compounds; thus the test should be of value in production-control work. For example, the exotherm time of Compound B (1.12 min.) is longer than that for Compound A (0.69 min.) primarily because Compound B has no medium-range catalyst (e.g., benzoyl peroxide) and contains slightly more inhibitor. Compound G is slower (1.25 min.) than either compound because it contains less resin and more filler.

At 250° F., the effect of the different catalyst systems becomes easier to see. For those compositions which do not contain a medium-range catalyst, the rate of reactivity is slower at 250° F. because of the slower decomposition of the catalyst. Also the exotherm time for compositions which do not contain a medium-range catalyst is significantly longer than those which do. For example, Compound B (which contains slightly more inhibitor and no medium-range catalyst) has an inflection-to-peak or cure time of 5.65 min., as compared with 3.15 min. for Compound A (which does contain such a catalyst.)

At 230° F., differences are emphasized even more. Compound B has an inflection-to-peak time of 9.75 min. while for Compound A, the time is only 3.91 minutes.

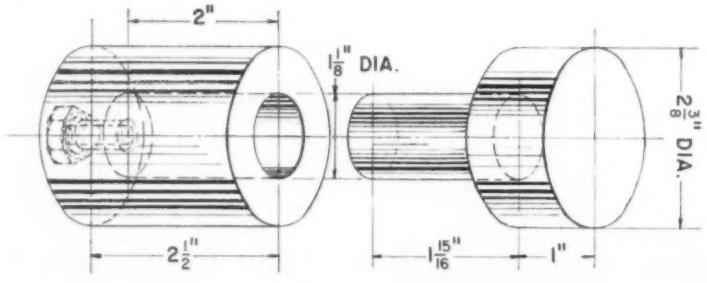
The effect of the bath or mold temperature and catalyst system on reactivity is further illustrated in Table II, p. 125. This reports the reactivity times for one compound, Thermaflow C, formulated with three different catalyst systems, each measured at 300, 250, and 230° F. A comparison of inflection-to-peak times shows particularly well the effect of using an initiator catalyst at a temper-

Table III: Molding time vs. Barcol hardness and gloss

Time min.	*Barcol hardness*	*Gloss*
Mold temperature 300°F., 2000 p.s.i.		
.50	0	5 – 7
1.00	46 – 55	4 – 7
1.50	46 – 50	20 – 25
2.00	48 – 55	34 – 37
2.50	54 – 60	40 – 52
3.00[1]	50 – 60	45 – 50
3.50	48 – 55	43 – 52
4.00	50 – 58	48 – 53
Mold temperature 250°F., 2000 p.s.i.		
3.00	0 (Soft)	5 – 7
5.00	0	14 – 16
7.00[1]	33 – 47	28 – 34
9.00	42 – 48	28 – 38
Mold temperature 230°F., 2000 p.s.i.		
3.00	Soft	—
7.00	0	7 – 11
10.00	0	14 – 22
13.00[1]	0	12 – 22

[1]Cure time predicted from reactivity time.

FIG. 4: Dimensions of cylinder and piston used for room-temperature extrusion tests. Threaded hole at bottom of cylinder receives test orifices.



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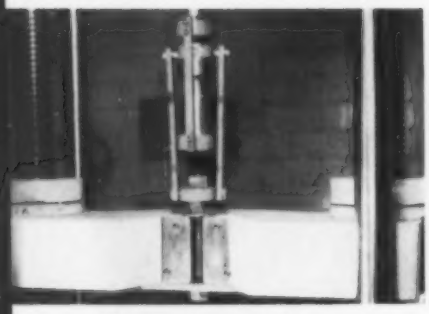


FIG. 5: Special holder in which extrusion cylinder of Fig. 4 is mounted on the variable-speed crosshead of the testing machine.

ature below its most effective "ignition" point. At 250° F., the standard catalyst system has an inflection-to-peak time of 4.17 min., while for the 1% dicumyl peroxide (Dicup) system the time increases to 10.26 minutes. The third catalyst system containing Dicup, benzoyl peroxide, and inhibitor is slightly longer at 11.56 minutes. Furthermore, at this temperature the total reactivity times are prolonged and the peak temperatures are reduced by 20 to 50° F.

Correlation with molding

The next step was to learn how well the foregoing reactivity data predicted the molding characteristics of the compounds. Compound B was molded at mold temperatures of 300, 250, and 230° F., corresponding to the test-bath temperatures. As reported in Table I, the 150° F.-to-peak times for this compound are 3.04, 7.57, and 13.08 min. at bath temperatures of 300, 250, and 230° F. respectively. The compound was molded at these temperatures for varying lengths of time to establish the period necessary to obtain a satisfactory cure. High surface gloss[1] and Barcol hardness values were taken as an indication of complete cure. The gloss and hardness values (taken as an indication of complete cure) obtained from the various molding cycles are listed in Table III, p. 128.

At 300° F., Compound B was still a soft, sticky mass after 0.5 min. in the closed mold. After 1 min., a slab having a Barcol hardness of 46 to 50 and a gloss value of 4 to 7 was produced. After 2.5 and 3.0 min., hardness values of 54 and 60 and gloss values of 40 to 50 were obtained. No better values were obtained when the molding cycle was increased to 4 min., indicating that cure was complete after 2.5 to 3.0 minutes. This figure is startlingly close to the reactivity time of 3.04 min. obtained in the laboratory test.

At 250° F. the reactivity time was 7.6 minutes. After 3 min. in the closed mold, the compound was still soft and sticky. After 5 min., a slab was obtained, but it had no hardness. And after 7 min., the molded slab had a Barcol hardness of 33 to 47 and a gloss value of 28 to 34.

At 230° F., where the reactivity time was 13.43 min., the compound was still soft and workable after 3 min. in the mold. After 7 min., a slab was produced having no hardness and a gloss value of 7 to 11. After 13 min., though the gloss value rose to 22, the resulting slab still had no hardness.

From the results of Table III it appears that only at 300° F. is there a direct correspondence between the reactivity of a Thermaflow molding compound in a test tube and its molding time in a press.

Fortunately, 300° F. is the approximate molding temperature for these compounds. However, for compounds designed to be molded at 250 and 230° F., good correlations would also be expected between molding time and reactivity time. Actual gel time could not, of course, be observed in the press and thus could not be correlated directly with the measured 150° F.-to-inflection time, but the total curing time does correspond very closely with the measured 150° F.-to-peak time at 300° F. Gelation may possibly take place before the inflection point, but this can be determined only by a refinement in the test method.

[1]Photovolt Corp. gloss meter, Model 610.

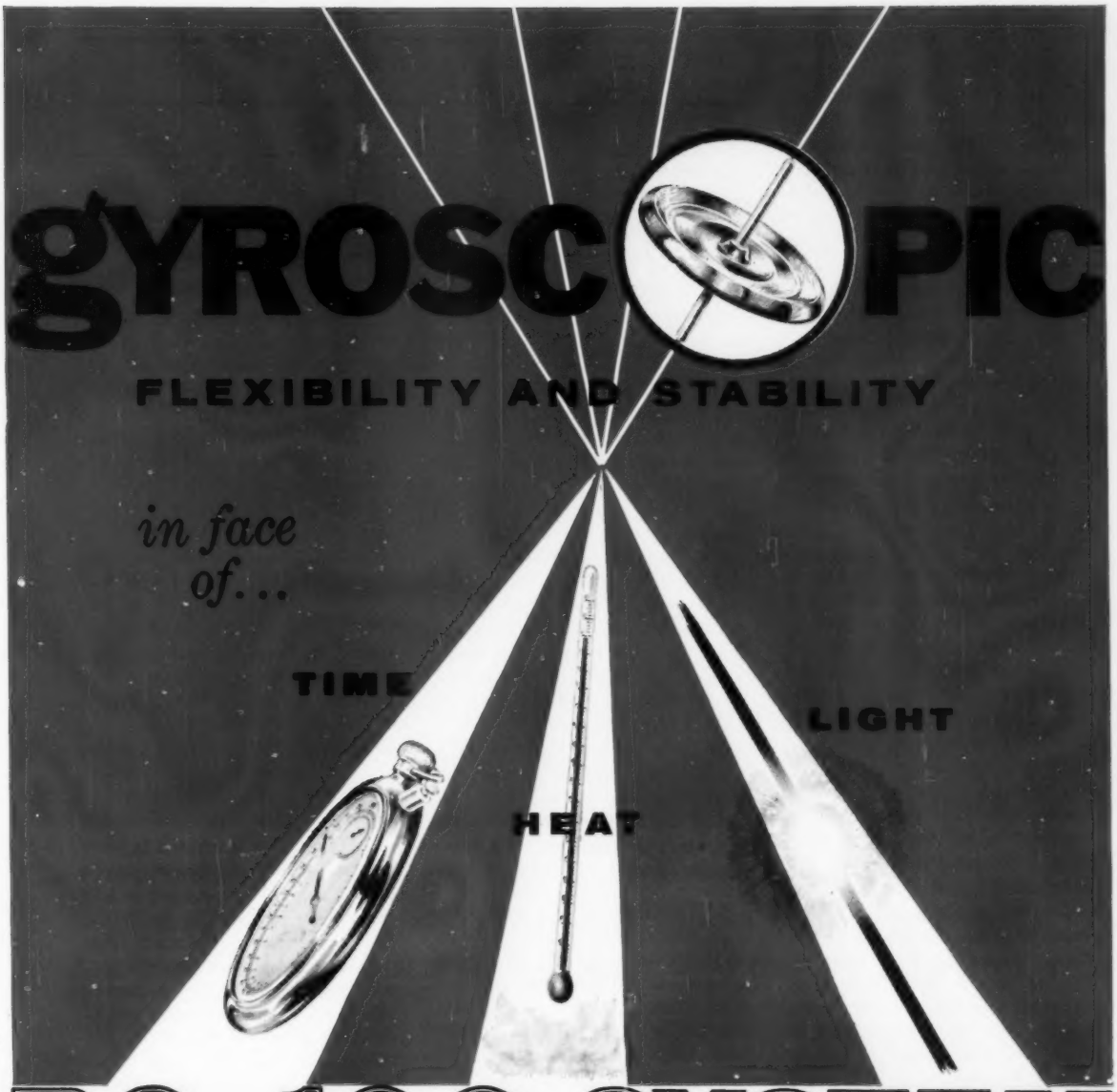
ROOM TEMPERATURE EXTRUSION TEST

This test measures the pressures developed while extruding a sample of premix at a constant rate of speed through a standard orifice at room temperature (73° F.) *(To page 132)*

Table IV: Summary of extrusion test data

Compound	No. of batches tested	Average extrusion pressure	Range of average values	Spread of average values	Average maximum extrusion pressure	Range of maximum values	Spread of max. values	Average minimum extrusion pressure	Range of minimum values	Spread of min. values
		p.s.i.	p.s.i.	p.s.i.	p.s.i.	p.s.i.	p.s.i.	p.s.i.	p.s.i.	p.s.i.
A	4	304	210-370	160	397	260-520	260	212	150-250	100
H	2	252	245-260	15	320	315-325	10	200	165-235	70
B	4	275	190-400	210	420	290-700	410	159	140-200	60
E	5	393	235-675	440	662	390-1200	810	188	120-295	175
I	2	330	200-460	260	730	280-700	420	311	145-220	75
F	3	274	182-340	158	325	225-410	195	306	160-235	75
G[1]	3	956	725-1000	325	1110	900-1200	300	809	605-1100	595

Notes: (1) *Average extrusion pressure* — the composite-average of the average extrusion pressure for duplicate determinations on each batch tested. (2) *Range of average values* — The lowest average extrusion pressure to the highest extrusion pressure recorded for the batches tested. (3) *Spread of average values* — the difference between the highest average extrusion pressure and the lowest. (4) The same terminology is used for the maximum and minimum extrusion values. (5) [1]½-in. orifice; all others, ¼ inch.



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The test was developed in the hope that (1) a correlation would be found to exist between the maximum pressure required for extrusion and the maximum strength in the final part and (2) that variations in extrusion pressure would indicate variations in strength due to differences in compound composition. An ideal compound would, therefore, be strong enough for the intended use, and that strength would be indicated by the average pressure required for extrusion. Likewise, the ideal compound would show very little variation in extrusion pressure throughout the test, indicating maximum uniformity.

The extrusion test is conducted in a steel cylinder with a closely fitting piston having a cross-sectional area of 1 square inch. The bottom of the cylinder is threaded to receive a removable bushing holding one of several orifices through which the test compound is extruded. (See Fig. 4, p. 128.) The orifice diameter may be ⅛, ¼, or ½ inch.

The extrusion cylinder is placed in a special holder (Fig. 5, p. 130) mounted on the variable-speed crosshead of a Tinius-Olsen Universal Tester. The tester is equipped with a pen-type recorder to provide a graphic time record of pressures exerted on the piston during extrusion test.

Procedure: A 30-g. sample of the molding compound was loaded into the cylinder which was then inserted into the holder on the crosshead. The crosshead was lowered until it made contact with the top of the piston. The ¼-in. orifice was used for all the glass-reinforced compounds, and the ½-in. orifice used for the stiffer, more viscous nylon-reinforced compound.

Table V: Effect of additional fast mixing time on compound prepared at 2 min. slow speed

Additional fast mixing time	*Extrusion pressure p.s.i.*			*Izod impact*
min.	*Avg.*	*Max.*	*Min.*	*ft.-lb./in. notch*
0	380	585	230	4.66 ± 2.70
10	450	540	375	2.81 ± 1.94
20	377	430	310	2.09 ± 0.92

The extrusion tests were conducted using the 1200-lb. scale of the tester. The downward rate of travel of the crosshead was set at 0.1 in./min., and the chart speed of the recorder at 0.5 in./min. The test duration was 4 min., which provided a 2-in.-long graphical record for measuring extrusion pressures.

To obtain representative results, several batches of each premix compound produced over a span of several months were tested. Two samples from each batch were used. The resulting chart records were analyzed for maximum, minimum, and average pressures attained during each run. The range of values thus obtained provide the basis for evaluating the degree of homogeneity and other properties of the compounds tested.

Test results

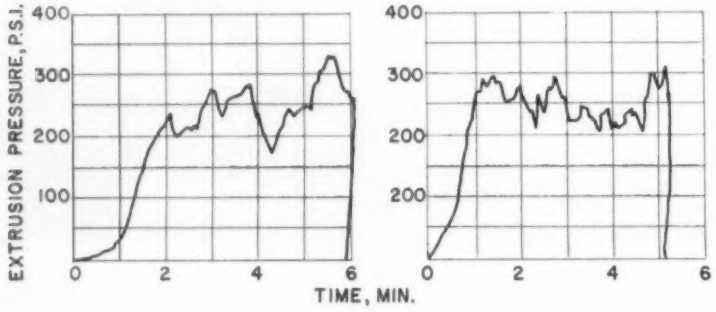
In compounds having no reinforcing material, the extrusion pressure would be practically constant throughout the run, resulting in an essentially flat curve with little fluctuation. However, compounds which contain reinforcement are inherently heterogeneous and normally exhibit pressure fluctuations during extrusion through a ¼-in. orifice. As shown in Fig. 6, below, fluctuations occur even in duplicate samples from the same batch. However, for each product there is a normal range of values by comparison with which an unsatisfactory batch can be detected.

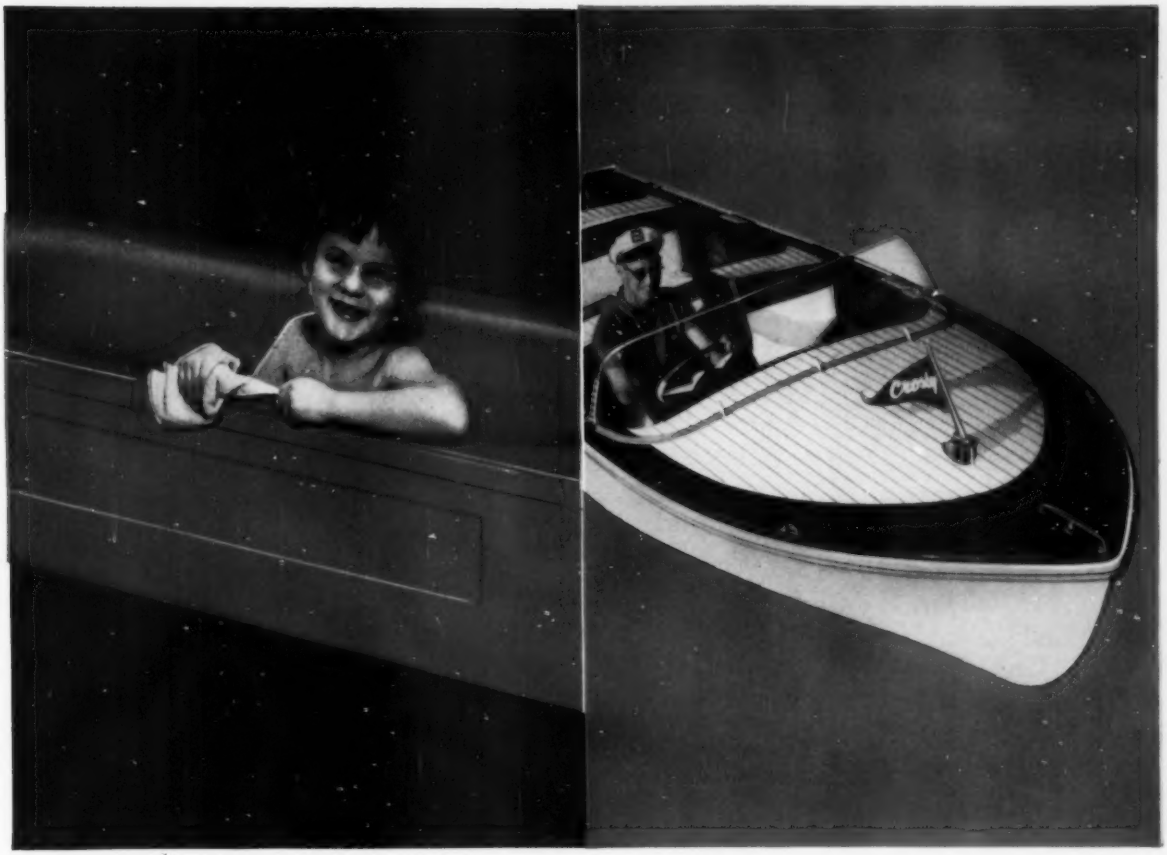
Table IV, p. 130, summarizes the maximum, minimum, and average extrusion pressures recorded for seven premix compounds. The averages and range of values for each compound are based on several different batches of the compound with duplicate determinations for each batch. These average extrusion pressures and ranges between maximum and minimum values can be most useful in differentiating between "normal" and "abnormal" compounds, Fig. 7, p. 134, illustrates how the graphical results of an extrusion test shows batch-to-batch variation in premix.

Although further work is necessary before test results can be clearly related to composition and production methods, some initial tests have shown that such relationships exist. For example, increasing the amount of glass reinforcement raises both the extrusion pressure and the spread between the maximum and minimum values. As shown in Fig. 8, p. 134, increasing glass content from 30 to 37% raised maximum extrusion pressure from 325 to 512 p.s.i. and increased spread between maximum and minimum pressures from 135 to 263 p.s.i. In this manner a variation in glass content between compounds, or from batch to batch of the same compound, can be detected.

The effect of mixing time can also be observed. Table V, above, illustrates the decreased spread between maximum and minimum extrusion pressures of an experimental-mixer compound when subjected to increasing periods of fast mixing. This greater uniformity is attributed to degradation of the glass fibers caused by the mixing. The improved uniformity,

FIG. 6: Fluctuations of the extrusion pressure on duplicate samples from the same batch of compound.





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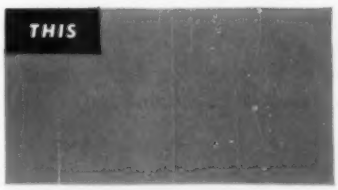

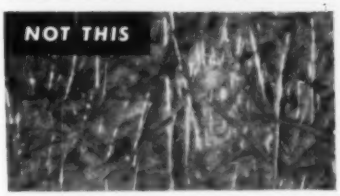

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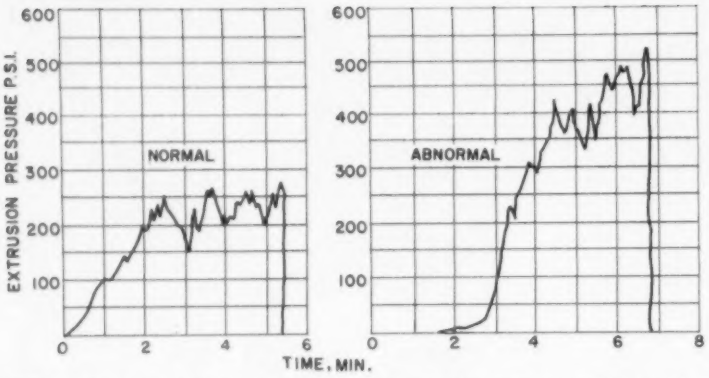

FIG. 7: The batch-to-batch variations in the extrusion tests are useful in differentiating between the "normal" and "abnormal" compounds.

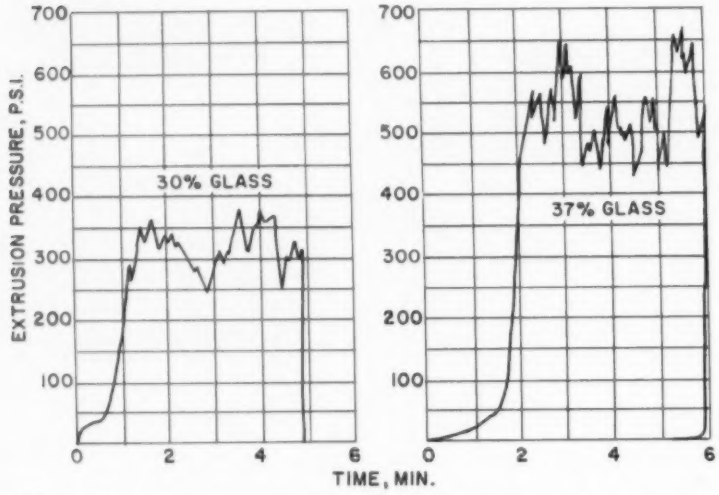

FIG. 8: The pressure-time records show that the increase in glass content of a premix compound increases the maximum test extrusion pressure and the spread between the maximum and the minimum pressures.

Table VI: Probable causes of abnormal values obtained in the reactivity and extrusion tests

Symptom	*Accompanying condition*	*Probable cause*
Extrusion pressure:		
Too high	Peak temp. normal or low	Too high % reinforcement
Too low	Peak temp. high	Too much resin
Wide variation	Erratic reactivity	Poor wetting, inadequate mixing
Peak temperature:		
Too high	Gel time OK	Too high % resin or too much high temp. catalyst
Too low	Gel time OK	Too little resin, too little high temp. catalyst
	Gel time OK but exotherm time long	Too little high temp. catalyst
Gel time:		
Too long	Peak temp. OK	Too much inhibitor, or too little low temperature catalyst
	Peak temp. low	Too little resin, too much inhibitor
Too short	Peak temp. OK	Too much low temp. catalyst

however, was accompanied by reduced impact strength, a side effect which can possibly be avoided or minimized by modifying the mixing technique. Thus the extrusion test can be used to correlate mixing time with optimum balance between uniformity and impact strength. Uniformity of the compound is highly desirable since it helps make the distribution of strength in the molded part more uniform.

Non-uniform wetting of the glass in one compound showed up in the form of abnormally wide fluctuations in extrusion pressures, with the unwet regions producing high peaks and the resin-rich areas unusually low minimums.

In all tests, the reproducibility between samples of a given batch was good. Furthermore, there was relatively little fluctuation among different batches produced under the same processing conditions. This suggests the high reliability of the extrusion test for quality-control purposes. Moreover, when used in combination with the reactivity test as described below, it can provide a useful method for troubleshooting the unsatisfactory compounds.

Troubleshooting

Used individually, the reactivity and extrusion tests offer a quantitative basis for measuring the effect of experimental changes in the composition of molding compound. However, in other situations it may be necessary to find the cause of unsatisfactory molding properties of a compound, or at least to narrow down the possible causes quickly. Used together, the two tests can be very helpful in troubleshooting. Table VI, left, shows how the results of both tests may be correlated to find the probable cause of abnormal performance. Further experience will doubtlessly result in refinement of these tests and closer correlation of the results with actual molding properties. Even in their present state, they are useful in establishing quantitative standards, evaluating and predicting performance, and controlling some of the variables in formulating and molding premix compounds.—END

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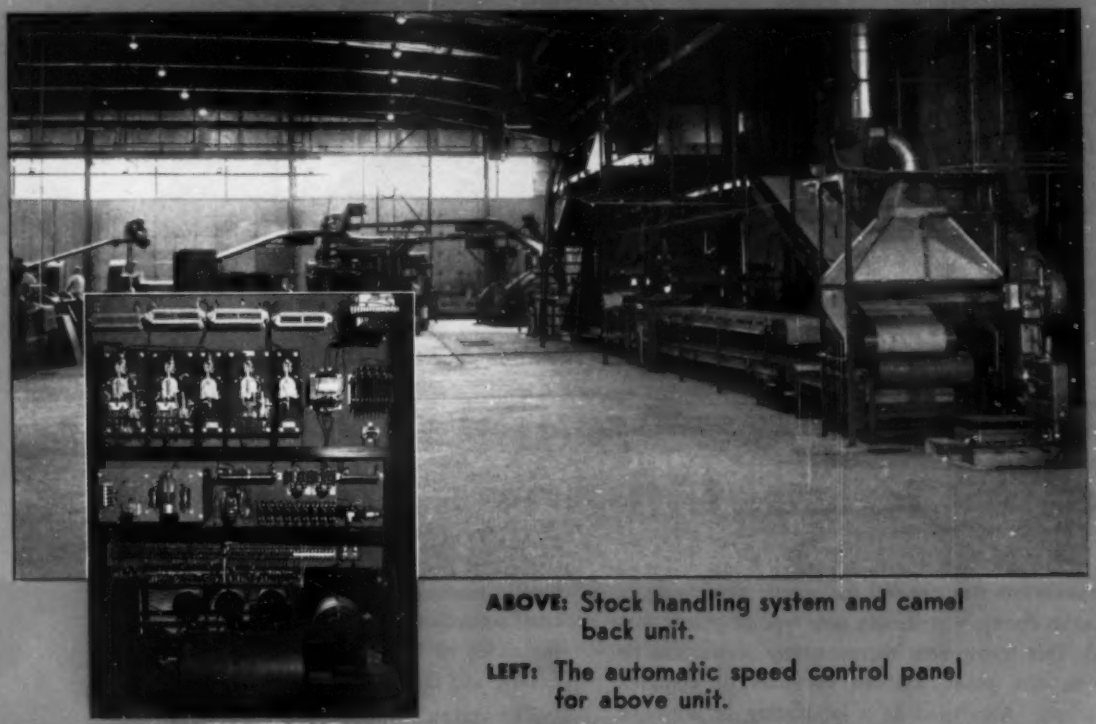

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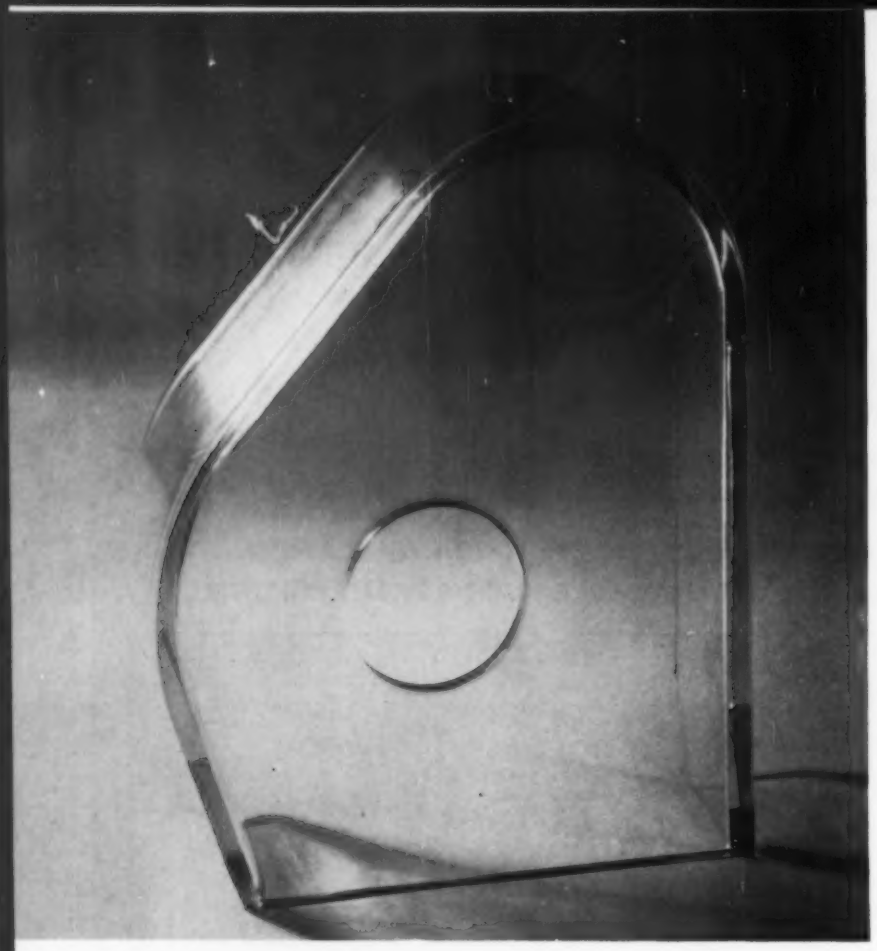

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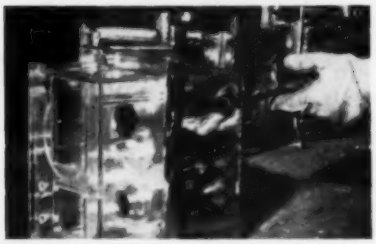
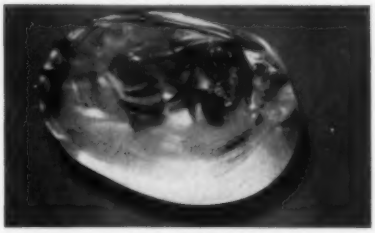


No vacuum or special equipment is necessary for easy production of durable, weather-resistant Maraglas castings in any size or shape.



Water-clear Maraglas has 90% light transmission. Castings are bubble-free. (Embedment by Miracle Plastic Mfg. Co., New York City).

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PLASTICS*
TECHNICAL SECTION

MATERIALS • PROPERTIES • TESTING METHODS AND INSTRUMENTATION • STANDARDS • CHEMISTRY

Behavior of reinforced plastics at very high temperatures—Part 2

By I. J. Gruntfest†, L. H. Shenker†, and V. N. Saffire†

A systematic study of the physical nature of the damage to selected reinforced phenolic plastics in high temperature environments is reported. The tests were made in the plasma of a water-stabilized arc at temperatures up to 23,400° F. High organic content compositions are shown to perform best at the highest temperatures, while high inorganic content materials are superior below about 6000° F. Examination of the surfaces and cross-sections of damaged specimens reveals some distinct relationships between composition, exposure conditions, and nature of the surface, as well as three different types of damage. The significance of steady state conditions as related to these experiments is also discussed. The techniques described may be useful for predicting the behavior of materials in severe thermal environments, or in estimating the conditions to which they have been exposed.

Surfaces of vehicles flying through the atmosphere at hypersonic speeds, in the neighborhood of Mach 20, may be exposed to gases heated to 9000° F. and above. These temperatures are higher than can be achieved in chemical flames or solar furnaces. Furthermore, they are above the melting and vaporization points of any known substance, and scientists are uniformly pessimistic about the invention or discovery of new solids that will be stable at these temperatures.

Some surface structure must be provided for vehicles of this type. Designers have resorted to novel and ingenious devices and systems which they hope will insure survival until completion of a mission. The use of a material that erodes slowly—or ablates—is an example of such a device. It is now clear that reinforced organic plastics are useful in this context and in others involving exposure to high temperatures for short periods of time. Applications ranging from the inlet ports of ramjet engines (1)[1] to the tail parts of solid fuel rockets have been cited (2, 3), as well as thermal shields for long range ballistic missiles (4) and deflectors for rocket exhausts (5). In addition, the durability of these materials under strong thermal radiation (6) and under severe aerodynamic heating (7) has been reported. Other workers have described the resistance of various reinforced plastics to jet engine afterburner blasts (8), recent advances in the development of heat resistant plastics (9), and methods of measuring the thermal properties of reinforced plastic laminates under transient high temperature heating conditions (10).

Organic plastics have been reported more durable than refractory ceramics and metals when exposed to very hot gases (11). Further, high organic content compositions performed better than those with a high content of inorganic material. More recently,

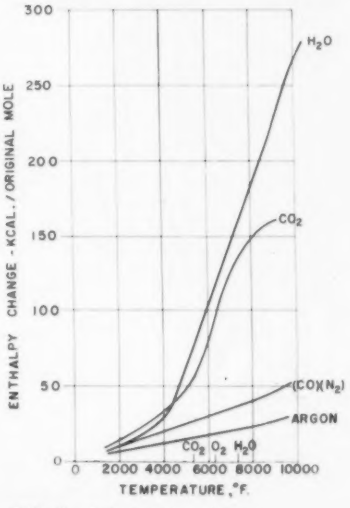

FIG. 1: Calculated enthalpy as a function of temperature for various gases.

*Reg. U. S. Pat. Off.

†Missile and Space Vehicle Department, General Electric Co., Philadelphia, Pa.

[1]Numbers in parentheses link to references at end of article, p. 148.

Presented at the 14th Annual Technical and Management Conference, S.P.I. Reinforced Plastics Division, in Chicago, Ill., Feb. 3, 1959. Part I was published in the June 1958 issue of Modern Plastics, p. 155.

a rationalization of the remarkable resistance of some of these materials to thermal attrition was given (12). Evidence was presented indicating a crossover in relative performance of high versus low organic content compositions as the temperature of exposure was varied. Even though these represent a departure from the ordinary applications of plastics, the materials used were conventional commercial products. In view of the importance of the new, high temperature applications, some attention should be given to the design or development of polymeric materials that are particularly suitable under such conditions.

The attrition of reinforced plastics that occurs during severe heating is a rather complicated process. To do an appropriate materials development job, some understanding of this is desirable. One step in an attempt to achieve this understanding is a detailed study of the physical nature of the damage to the material produced by the exposure. To this end we have made a systematic study of the behavior of a selected group of materials in environments of graded severity. Some of the observations may be useful in predicting the behavior of materials in severe thermal environments or in estimating the conditions to which they have been exposed.

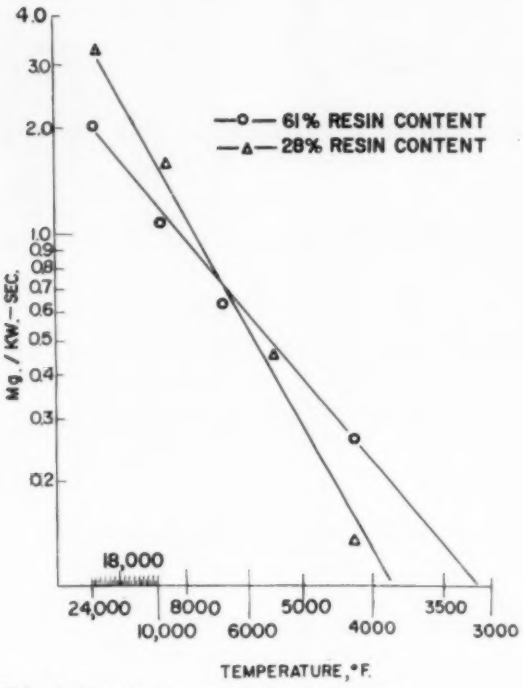

FIG. 5: Weight loss versus the temperature, phenolic-Refrasil.

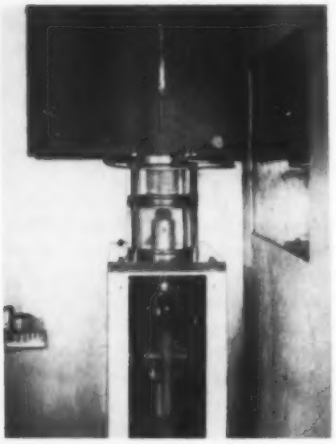

FIG. 2: Water-stabilized arc with model in place.

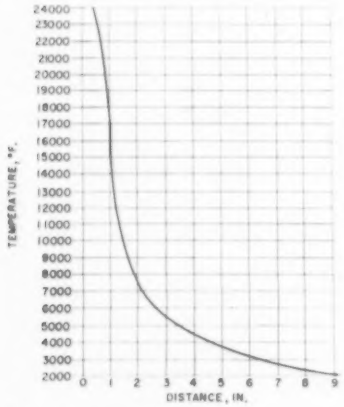

FIG. 3: Temperature at center axis of water-stabilized arc (63 kw.).

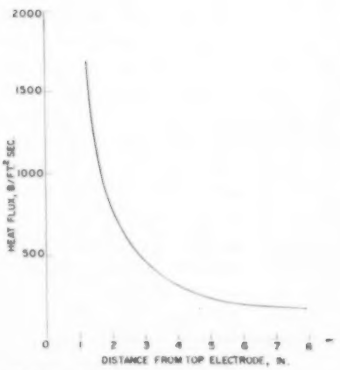

FIG. 4: Heat flux of water-stabilized arc (63 kw.) to a cold surface versus distance from nozzle.

It must be pointed out that there is no one high temperature problem. Examination of the literature cited indicates that each application may be distinctive. Any consideration of the response of reinforced plastics to very hot environments must involve the temperature of the environment, the rate of energy flow into the material, the chemistry and kinetics of pyrolysis, and the interaction of thermal and mechanical stresses.

It has been postulated (12) that the chemistry and kinetics of pyrolysis may be decisive in the erosion process. Obviously much more detailed chemical and physical studies are required to aid the designer in the choice or development of the most suitable material for a particular application. The work described in this article, however, does help provide some of the "feel" for the problem, which is so important in design.

Testing procedures

The selection of the test apparatus and the development of useful evaluation techniques for

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For example, the type of data readily available for most plastic materials is a single measurement of stress at a fixed time and strain (see fig. 1). This "quality control data" is helpful but usually not adequate. Going one step further, information is available on what we refer to as "screening data" which shows stress as a function of time at constant strain (see fig. 2). Yet this data offers no information on the important influence of strain.

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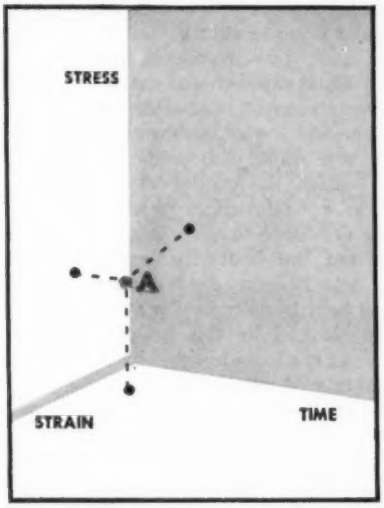
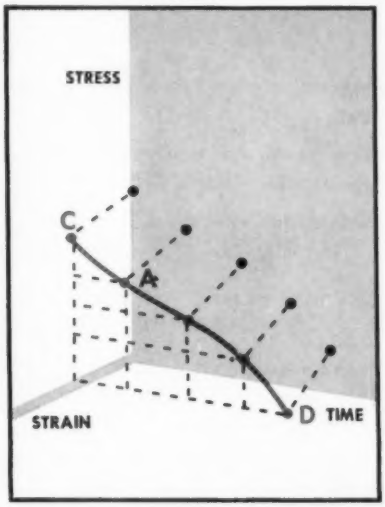
FIGURE 1



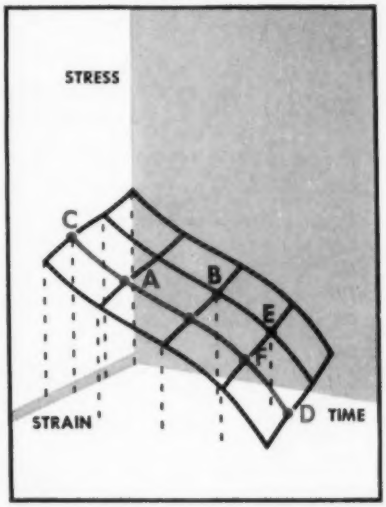
For controlling quality, a single measurement of stress (Point A) at some fixed time and strain within the elastic region could serve the purpose.

FIGURE 2



Screening products for new applications usually requires more information. Thus, stress at constant strain could be determined at various times (line C-D).

FIGURE 3



Design and engineering require more data at more conditions than described in figures 1 and 2. Stresses (Points A-B-E-F) must be determined at several different strains and times.

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materials to be exposed to hot gaseous environments demand a detailed understanding of the nature of the interaction between surfaces and hot gases. These interactions may be chemical, mechanical, and thermal. With respect to the thermal interactions, the heat flow to the body depends more on the enthalpy[2] gradients existing in the gaseous boundary layer than on the temperature gradients (13). This point is important to the proper correlation of test results because the enthalpy-temperature relations are markedly different for different gases. Thus, apparent contradictions in test data at a particular temperature can be generated if possible enthalpy differences are ignored.

There are several laboratory evaluation methods now in use for the ranking of materials with respect to their attrition rates in hot gases. These include exposure to: 1) hydrocarbon-oxygen flames such as are generated by rocket motors or torches; 2) cyanogen-oxygen flames as above; 3) arc plasmas of various compositions.

[2]Enthalpy $= \Delta H_{T_2, T_1} = \int_{T_1}^{T_2} C_p \, d\,T$; it is related to the heat storing capacity of the gas.

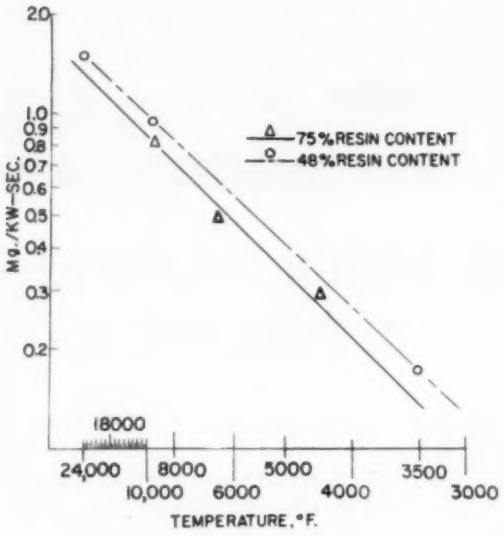

FIG. 7: Weight loss versus temperature, phenolic-nylon.

Figure 1, p. 137, presents approximate temperature-enthalpy data for several environments of interest (14). It can be inferred from this chart that a water-stabilized arc plasma would present the widest range of enthalpies for test environments.

The tests reported in this paper utilized the water-stabilized arc described previously (11). It is pictured in Fig. 2, p. 138, with a specimen in place before exposure. As the distance of the model from the exit nozzle increases, the temperature and heat flux decrease. The temperature along the axis of the jet was determined over the range of interest. Figure 3, p. 138, presents these data, which were obtained as follows: 8100 to 23,400° F.—The temperature was determined by emission spectrography, utilizing the ratio of certain calcium ion lines to calcium atom lines (15); 3000 to 6500° F.—The melting points of fine wires of rhodium, iridium, and palladium were used in locating the corresponding position in the plasma; below 3000° F.—Readings of a chromel-alumel thermocouple were used to indicate the temperatures in the plasma at these locations.

The heat flux to which the models were exposed was measured by means of several types of copper calorimeter, both water-cooled and solid. The data obtained indicate the level of energy input to a cold surface that is neither decomposing nor injecting gases into the boundary layer. Under actual exposure conditions, the net heat transfer to the surface is reduced by this gas injection as well as by the high temperature of the surface of decomposing plastic. Figure 4, p. 138, presents heat flux to a cold surface in the plasma jet as a function of distance from the nozzle (16).

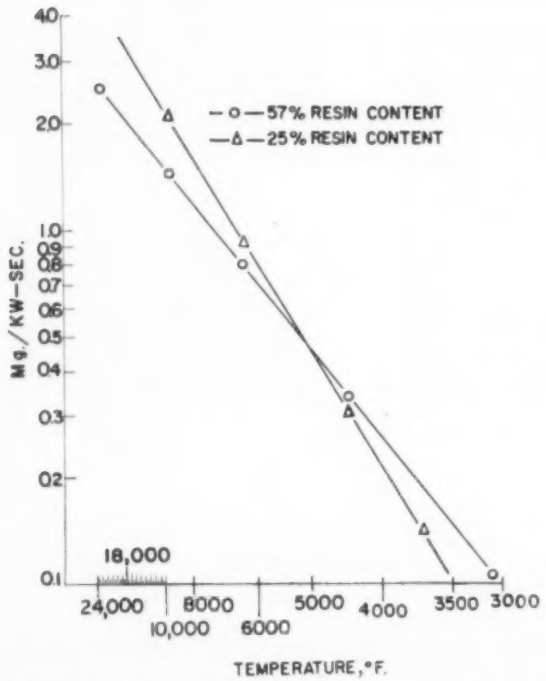

FIG. 6: Weight loss versus the temperature, phenolic-Fiberglas.

Materials

The high pressure molded samples used in this work were prepared from materials with a pre-

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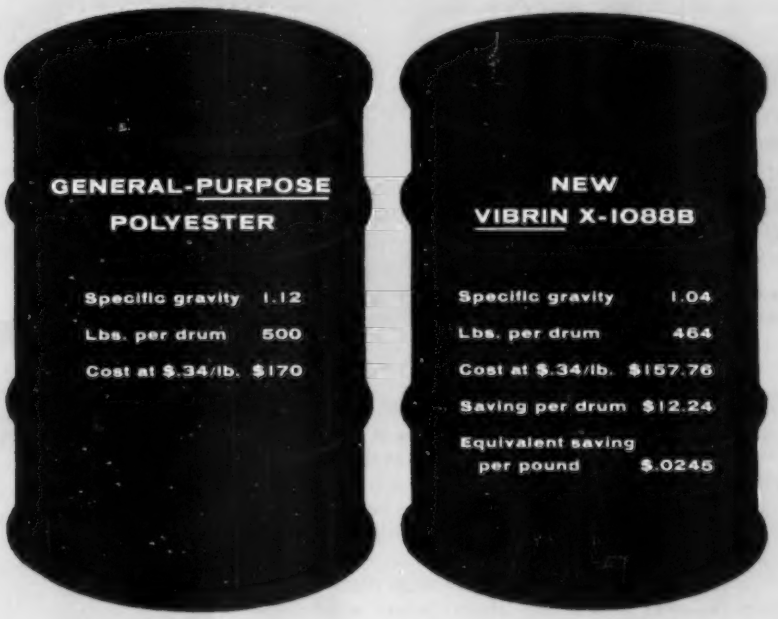

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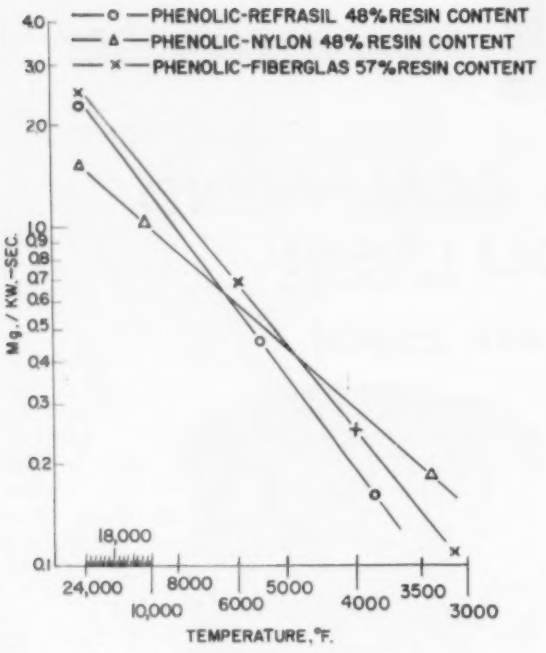

FIG. 8: Weight loss vs. temperature, phenolic-Refrasil,-nylon,-Fiberglas.

vious history of interesting high temperature behavior. The phenolic resin used throughout has performed well in other very high temperature tests. It is a laminating resin of the type normally utilized for long service at 400 to 500° F.

The reinforcements included a square weave nylon cloth, 181 Fiberglas[3] cloth with a Volan A[4] finish, and C-100-28 Refrasil[5] cloth with A-1100[6] finish. The resin was used as a prepreg on the cloth, which was then chopped for molding into 0.5-in. squares. Samples of various resin contents were prepared with each reinforcement.

Cylinders, 6 in. in diameter and 2 in. thick, were molded in matched metal dies at pressures in excess of 1500 p.s.i. The cure and post-cure cycles were in accordance with the manufacturer's recommendations, except in the case of the nylon-reinforced material, which was never heated above 300° F. Rods 0.5 in. in diameter by 2 in. long (the thickness of the molding) were utilized as specimens in all tests.

In all cases, the cylindrical side of the specimen was protected from exposure to the plasma by a phenolic-paper sleeve of 0.25 in. wall thickness. Thus, all gravimetric measurements could be based on the 0.5 in. diameter area which was exposed.

In operation, the arc was brought to equilibrium, the specimen swung into the plasma, held for the required length of time, and swung out. This particular apparatus was under semi-automatic control. The cathode orifice was 3/16 in. in diameter, and the net electrical input at the electrodes was held at 63 kw.

The test specimens were weighed before and after testing; the results are reported as mg.

[3]Owens-Corning Fiberglas Corp.
[4]E. I. du Pont de Nemours & Co., Inc.
[5]A high silica glass product of H. I. Thompson Fiber Glass Co.
[6]Union Carbide Corp.

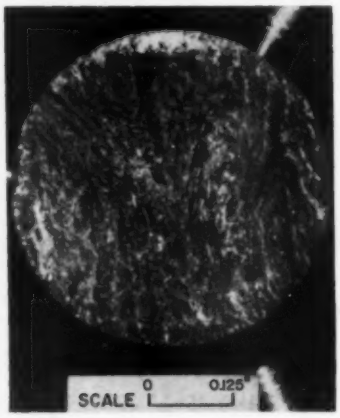

FIG. 9: Phenolic-Refrasil surface after exposure at 23,400° F.

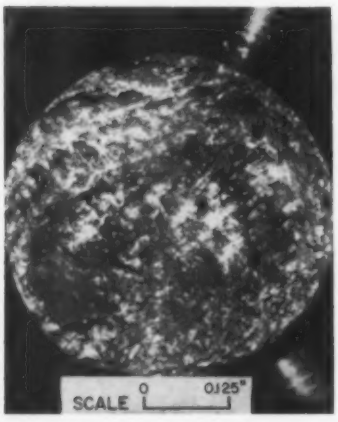

FIG. 10: Phenolic-Refrasil surface after exposure at 6000° F.

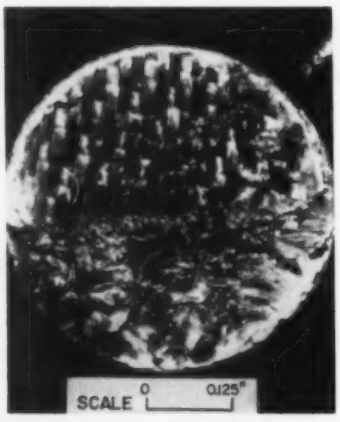

FIG. 11: Phenolic-Refrasil surface after exposure at 3700° F.

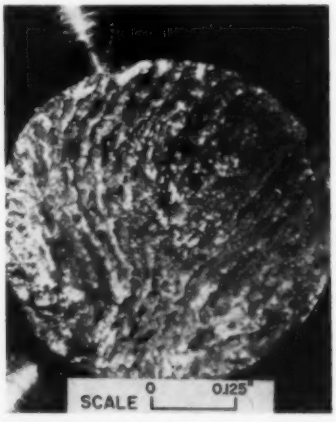

FIG. 12: Phenolic-Fiberglas surface after exposure at 23,400° F.

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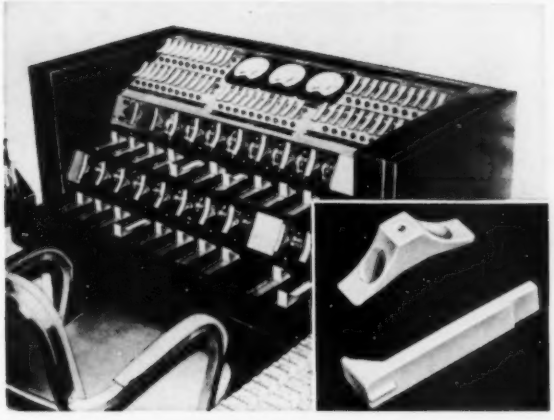

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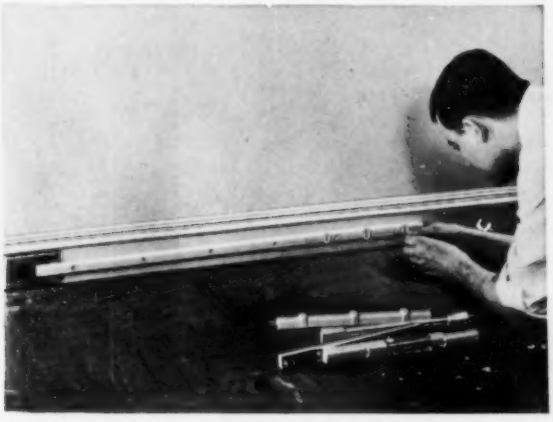

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weight loss per kw.-sec. of energy input at the electrodes. The majority of the runs were of 10-sec. duration. A systematic examination of the damaged specimens was carried out by a variety of analytical and microscopic techniques.

Phenolic-Refrasil specimens at 28 and 61% resin content (by weight) were exposed at positions corresponding to a 3200 to 23,400° F. range. The results are shown in Fig. 5, p. 138. A crossover in relative performance can be noted at 6300° F. At the higher temperatures the high resin content material is superior, while at the lowest temperature, the reverse is true.

Similar data for *phenolic-Fiberglas* specimens are presented in Fig. 6, p. 140, with a crossover in relative performance at approximately 5000° F.

The performance of *phenolic-nylon,* which represents an all organic system, shows little effect of changes in resin content (Fig. 7, p. 140). It is interesting, however, to compare its performance directly with that of the other materials studied. Figure 8, p. 142, indicates that *nylon-filled* phenolics are distinctly superior to the inorganic filled materials at the highest temperatures. Crossover temperatures of 5000° F. for Fiberglas reinforced materials and 6300° F. for Refrasil reinforced materials may correspond to points at which the inorganic materials are no longer fluid enough to be removed from the surface by the shear forces available in the plasma. The entire loss of material is then from the organic component.

These data confirm systematically, under controlled conditions, the superior performance of organic materials at very high temperatures, as well as the existence of crossovers in relative performance at particular lower temperatures. It should be noted that these crossovers in performance pertain to a particular test apparatus and environment. In a supersonic environment, such as a rocket exhaust, the high aerodynamic shear forces may cause more rapid removal of molten material, thus shifting the crossover temperature.

Examination of damaged surface

Direct examination of the damaged surface under low magnification (5 to 60X) reveals relationships between composition, exposure conditions, and nature of the surface. These can be observed in Figs. 9 to 17.

At the highest temperature (23,400° F.) the surface of the nylon reinforced material consists of a coke-like structure with a network of voids corresponding to the original nylon fibers. The lack of reinforcement in this char layer leads to the formation of fragile char caps which are periodically removed from the surface to leave it fairly clean. Under the same exposure, the surface of the two inorganic-reinforced compositions are similar in appearance to sand-blasted wood. Fiber orientation can be distinguished because of

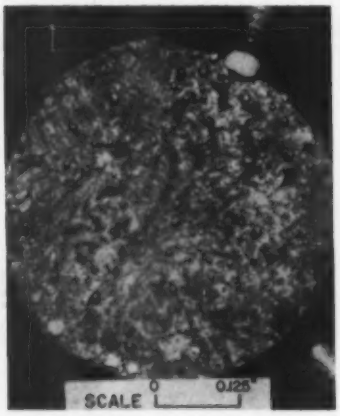


FIG. 13: Phenolic-Fiberglas surface after exposure at 6000° F.

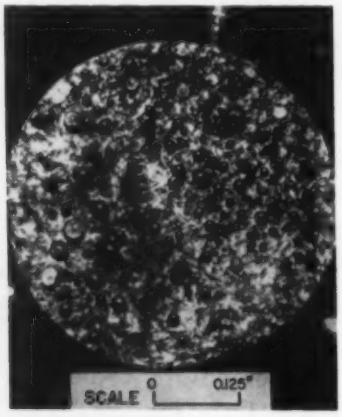


FIG. 14: Phenolic-Fiberglas surface after exposure at 3700° F.

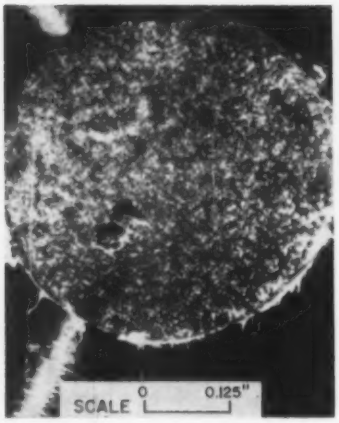


FIG. 15: Phenolic-nylon surface after exposure at 23,400° F.

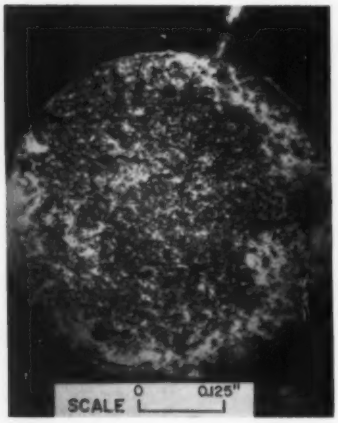


FIG. 16: Phenolic-nylon surface after exposure at 6000° F.

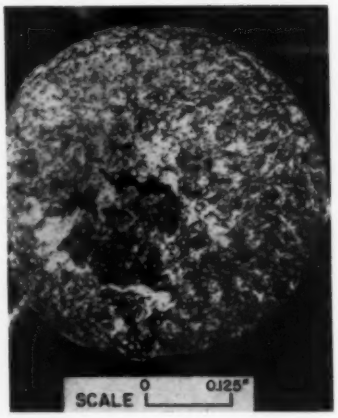
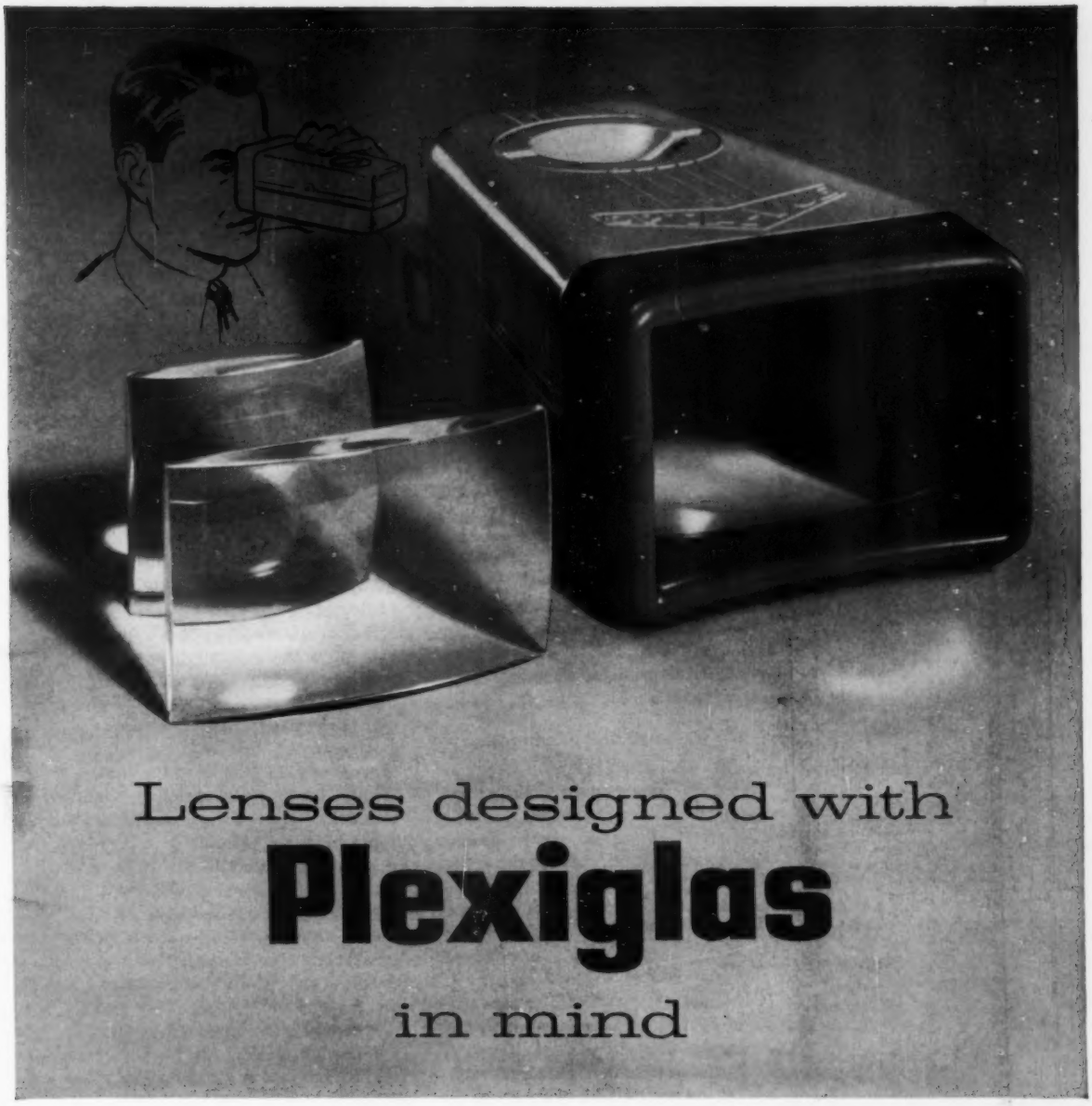


FIG. 17: Phenolic-nylon surface after exposure at 3700° F.



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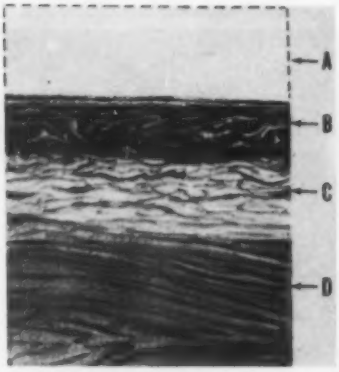

FIG. 18: Three zones of damage: A—Ablated zone; B—Carbonized zone; C—Secondary damage zone. D—Undamaged zone.

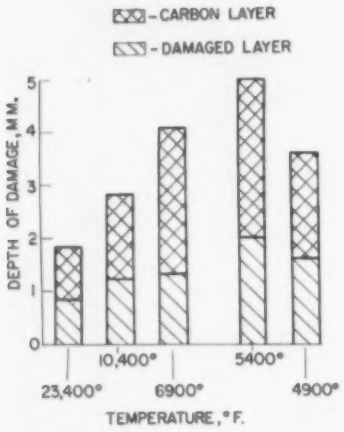

FIG. 19: Depth of damage in phenolic-Refrasil at various temperatures.

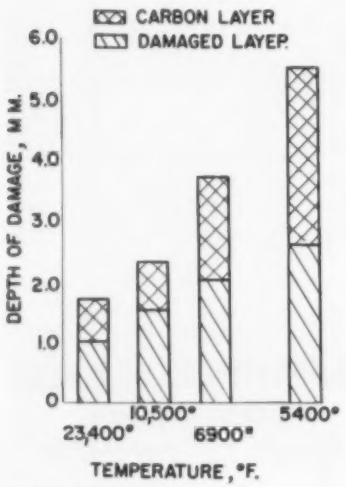

FIG. 20: Depth of damage in phenolic-Fiberglas at various temperatures.

slight differences in overall erosion of the two components.

At a lower temperature (10,300° F.) the surface of the high resin content, inorganic reinforced materials continue to show the "sandblasted" surface effect. The lower resin content samples reveal a very close-grained surface, and the Fiberglas reinforced material even shows some cavities.

The appearance of the surface of the heated nylon reinforced specimens is relatively unchanged with variations in resin content and temperature. However, in the specimens exposed at lower temperatures, there are some highly reflective surface particles which may be graphitic.

As the temperature of exposure is reduced, more and more glassy material appears in the surface of the inorganic reinforced samples. At lower temperatures, the beads of glass appear larger and larger, possibly indicating viscosity changes. Finally, at temperatures below 4000° F., the fibers of Refrasil remain intact, showing no macroscopic damage.

Cross-sectional examination

Examination of cross-sections of all specimens indicates that thermal damage occurs in three distinct stages, as shown in Fig. 18, above. First, there is the actual ablation, or removal of material from the surface (A). Second, there is the formation of a carbonized layer, with or without glass, and of various degrees of porosity (B). The third zone (C) of damage (secondary) is not as apparent as the others; it appears as a discoloration, crazing, cracking, or microscopic porosity of the layer behind the carbonized layer. It can readily be observed when a volatile liquid, such as acetone, evaporates from the polished surface of the section.

Depths of the two damaged layers versus temperature of exposure are plotted in Figs. 19 to 21. The depth of carbonization and secondary damage varies with temperature and resin content in the inorganic reinforced phenolics; the all-organic material shows little variation over a wide range of temperature and resin content.

The depth of secondary damage is slight at the highest exposure temperatures, but becomes greater as the temperature decreases. The depth of damage is greatest for inorganic reinforced materials.

The thickness of the carbonized layer increases with decreasing temperature, reaching a maximum at 5400° F. for Refrasil and Fiberglas reinforced materials. Below this temperature the carbonization rate and secondary damage appear to drop off slightly.

Steady state

Relevant to the above discussion is the question of whether a steady state has been reached at the time of observation or measurement. Two methods were used for this determination.

In Fig. 22, p. 148, gravimetric erosion data are presented for several materials exposed for varying lengths of time at 17,000° F. (15). In all cases, the tests at this temperature indicated a steady state of damage from 1 sec. on.

It is reasonable to expect, however, that as the temperature and rate of heat input are decreased, the time to reach a steady state will increase. Theoretical consideration of the heat transfer process (17) indicates that, ideally, for a given material, the product of erosion rate and total depth of damage should be a constant for all conditions where a steady rate exists. On this basis, Fig. 23, p. 148, indicates that steady state conditions existed for runs at all temperatures down to 8500° F. Below this temperature, either a steady state was not reached or the idealized theory was inappropriate.

The fact that a steady state of

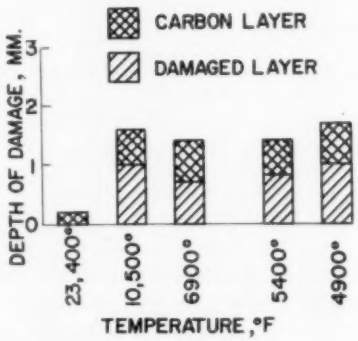

FIG. 21: Depth of damage in phenolic-nylon at various temperatures.

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erosion was generated in some of the experiments described here has implications which should be examined. In the absence of ablation, when the surface of a slab of solid is exposed to a very hot gas, a time-dependent temperature profile is generated. No steady state would be expected until, after very long times, the temperature of the slab becomes uniform. On the other hand, if the surface recedes—or ablates—at a uniform rate, it may tend to keep up with a particular profile and thus give rise to the observed steady state.

Furthermore, if a pyrolytic reaction such as carbonization takes place at a particular temperature, the depth of the carbonized layer will depend on the rate of ablation. The faster the ablation, the steeper will be the steady state temperature profile and the thinner the carbonized layer. The experiments confirm this, except when the heating rate is so low that the steady state may not have been achieved during the exposure.

In these experiments two damaged zones are observed. First there is a carbonized layer, and beneath this a zone of uncarbonized but crazed material. If the crazing also occurs at a particular temperature, lower than that producing char, the thickness of the crazed layer will also depend on the steady state temperature profile. The crazed layer will then be thicker at lower ablation rates.

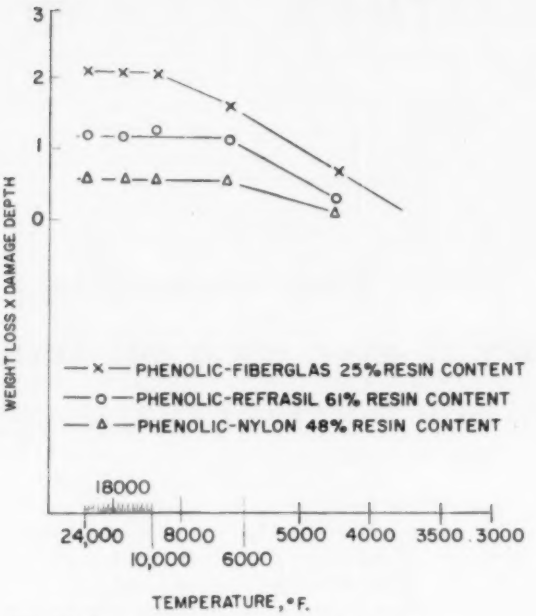

FIG. 23: Damage depth times the erosion rate versus the temperature.

Conclusions

Some of the physical details of the damage that occurs when reinforced organic plastics are exposed to environments of graded severity in the temperature range from 23,400° F. down to 3000° F. have been described. These data are relevant to the prediction of the ability of the materials to survive when exposed to very hot environments and are likely to be useful in evaluating the thermal history of a damaged specimen.

This information may also help in the development of more widespread understanding of the behavior of reinforced plastics at very high temperatures. Only through this understanding can the engineer or designer utilize the full potential of available materials, and the chemist develop still better ones.

The authors wish to express their appreciation to T. A. Harris, F. Conahan, Dr. R. E. Rippere, and Dr. W. H. Sutton for many of the tests and examinations.

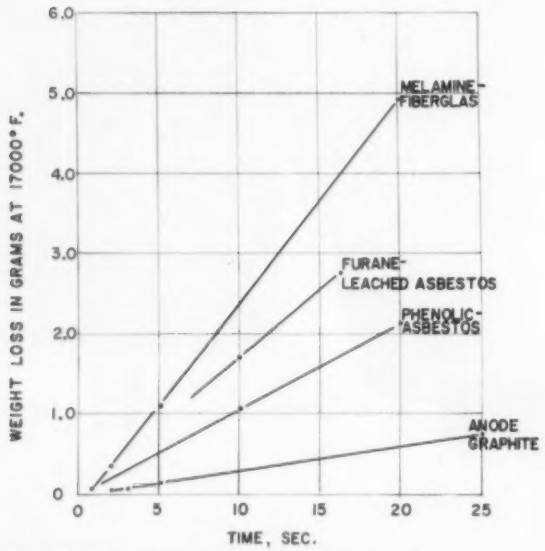

FIG. 22: Weight loss vs. time for various plastic compositions at 17,000° F.

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1. A. V. Levy, "Evaluation of reinforced plastics material in high speed guided missiles and power plant application," Plastics World *14*, 10-11 (Mar. 1956).

2. G. Epstein, and R. J. Brown, "Recent advances in plastic materials for rocket and missile construction," A.S.M.E.-A.R.S. Aviation Conference, Dallas, Texas, Mar. 1958.

3. D. V. Rosato, "Structural asbestos base plastic parts resist burning *(To page 204)*

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Mixed polyamides containing piperazine

By C. W. Hamilton* and M. M. Epstein*

This investigation was part of a program sponsored by the Signal Corps to develop materials for wire and cable jackets having improved flexibility and increased resistance to outdoor aging. Emphasis was specifically directed toward the investigation of nylon compositions, since these materials were inherently the best available on the basis of abrasion resistance, low temperature properties, and other excellent mechanical properties.

The more familiar polyamides, such as nylons 66, 610, and 6, are all noted for their high-tensile strengths and high melting points, and it is these properties that have won for nylon its wide acceptance in its primary applications. However, these polymers lack the degree of flexibility desired for wire and cable jackets, and, consequently, extensive modifications were indicated.

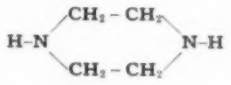
Several means of obtaining linear polyamides with different combinations of properties are known. For example, multi-ingredient systems of mixed polymers will give rise to a wide variety of properties. The results of these combinations are quite unpredictable and difficult to explain. Previous authors have attempted to relate observed changes in structure brought about by the disruption of hydrogen bonding, dipolar forces, molecular and planar symmetry, and crystallinity (1).[1]

Table I: Properties of copolymer systems containing piperazine

Nylon salt	*Composition by weight*	*Apparent molecular weight*	*Melting point*	*Tensile strength*	*Yield point*	*Elongation*
	%		°C.	p.s.i.	p.s.i.	%
66	100	11,700	265-268	9,100	8,400	264
Pip-10	0					
66	80	11,300	206-218	9,400	4,000	428
Pip-10	20					
66	50	12,400	150-158	6,200	3,400	370
Pip-10	50					
66	20	11,500	132-138	5,300	2,800	320
Pip-10	80					
66	0	10,000	173-175	6,200	4,700	328
Pip-10	100					
610	100	15,100	216	7,500	7,500	278
Pip-10	0					
610	80	14,100	209	8,200	4,500	372
Pip-10	20					
610	50	12,800	165-170	6,700	3,100	400
Pip-10	50					
610	20	9,700	136-142	4,600	2,500	326
Pip-10	80					
6*	100	—	205-210	18,500	4,600	300
Pip-10	0					
6	20	13,400	134-137	6,900	3,100	360
Pip-10	80					

*Data determined for Plaskon 8200, a commercial nylon 6.

Investigations of copolyamide compositions previously reported were primarily concerned with systems prepared from aliphatic diamines and diacids (2, 3). Examples of such polymers are polyhexamethylene adipamide-sebacamide (66/610) and polyhexamethylene adipamide-caproamide (66/6) copolymers, and terpolymers like 66/610/6. Mixed polyamides of this type exhibit considerable improvement in flexibility over the homopolymer constituents. In this investigation, searching for further improvement, emphasis was directed towards systems containing either aromatic or heterocyclic groupings. The materials most thoroughly studied were those based on piperazine, a heterocyclic secondary diamine whose structure is as follows:



This compound seemed particularly suitable for our purposes for several reasons: 1) being a secondary diamine, hydrogen bonding in the resulting polyamide is not possible. Therefore, high polymers containing piperazine should be weaker, more flexible, and melt at lower temperatures than copolymers containing only primary amino materials. As it turned out, this did not always hold true. 2) In the process of oxidative degradation of nylon, the active hydrogen attached to the amide linkage has been associated by some authors with the formation of peroxides, and consequent chain scission. Polymers without this type of hydrogen atom should,

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[1]Numbers in parentheses link to references at end of article, p. 206.

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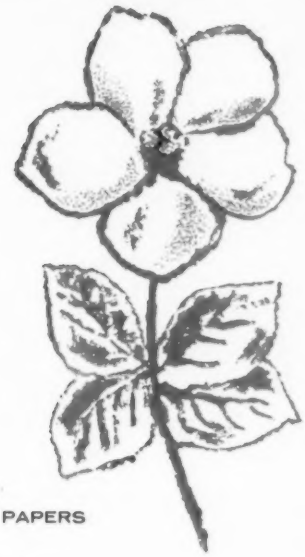

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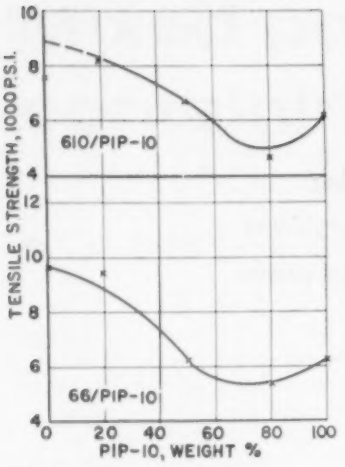

FIG. 1: Effect of piperazine on tensile strength of nylons 610/pip-10 and 66/pip-10.

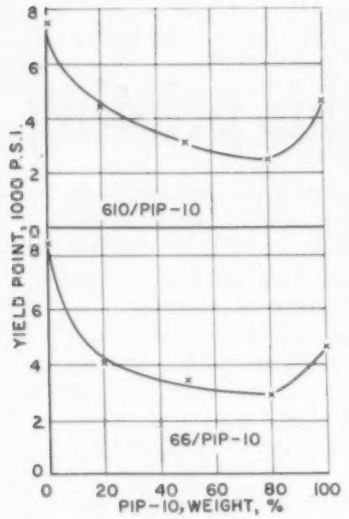

FIG. 2: Effect of piperazine on yield point of 66/pip-10 and 610/pip-10 copolymers.

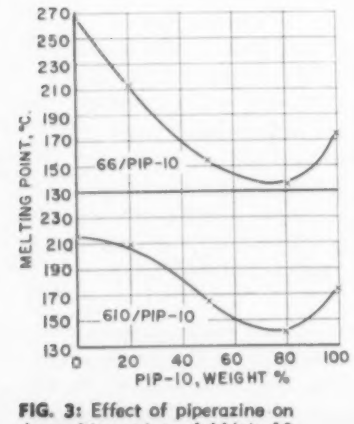

FIG. 3: Effect of piperazine on the melting points of 66/pip-10 and 610/pip-10 copolymers.

therefore, be more resistant to deterioration of this kind.

The preparation of homopolymers of piperazine with various diacids has been reported (4), although its effect on the properties of multicomponent systems has not. Hudgin and Brown have reported the synthesis of copolymers containing 2-methyl piperazine with suitable diacids; no mention of the effect on tensile properties was indicated (5).

Preparation of materials

The synthesis of these polymers was accomplished as follows: 50 g. of dry nylon salts, prepared from the corresponding diacids and diamines in an alcohol solution with the pH adjusted to the isoelectric point, were charged in the proper weight ratio to a 300-ml., three-necked flask. The salts were heated and agitated in an atmosphere of nitrogen at 230° C., with the byproduct water refluxed at atmospheric pressure. After 1½ to 2 hr., the water was slowly removed over a period of 1½ hr., until equilibrium was reached. The temperature was then raised to 285° C. and the pressure reduced to 2 mm. of mercury. Vacuum was retained until a molecular weight in the range of 10,000 to 15,000 was obtained.

All samples were ground into molding chips and extruded into an unoriented monofilament approximately 30 mils in diameter. The filaments were conditioned for 10 days at 23° C. and 50% relative humidity before testing.

Test procedures

The characterization of these polymers was specifically directed towards obtaining the following information: melting point, molecular weight, and the change in tensile strength, yield point, and elongation during heat aging. When possible, the stress at 0.5 strain, or the 50% modulus, was determined. In this report, either the latter or the yield point was used for comparing flexibility, realizing that they are not absolute measurements of that property. The tensile properties were measured either on a Dillon Universal multi-low range testing machine, or a Baldwin-Southwark tensile machine. When the

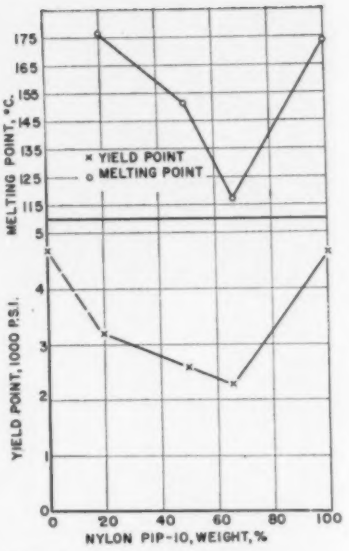

FIG. 4: Effect of nylon pip-10 on a 50/50 copolymer of nylons 66/610.

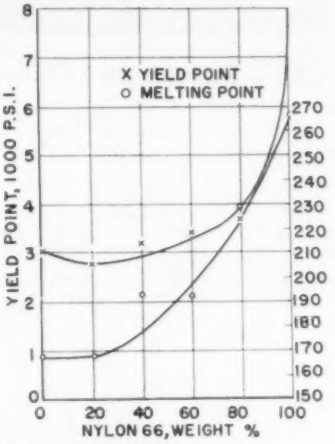

FIG. 5: Effect of nylon 66 on a 50/50 copolymer of nylons 610/pip-10.

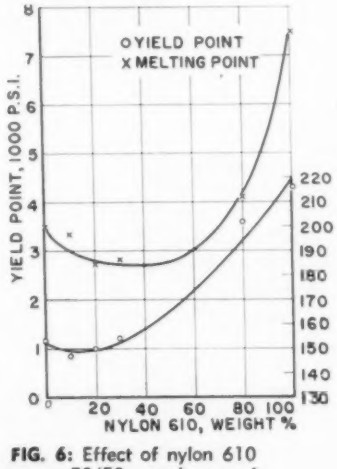

FIG. 6: Effect of nylon 610 on a 50/50 copolymer of nylons 66/pip-10.

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Table II: Physical properties of the nylon 66/610/Pip-10 system

Composition by weight	Apparent molecular weight	Melting point	Tensile strength	Yield point	Elongation
%		°C.	p.s.i.	p.s.i.	%
80/10/10	13,700	228-230	8,800	3,700	417
10/80/10	10,000	199-204	8,400	4,100	410
60/20/20	13,200	190-196	8,600	3,400	436
40/40/20	11,300	174-180	8,500	3,200	422
40/30/30	16,500	185-204	9,800	3,200	472
22/43/35	16,900	160-167	7,600	3,500	380
35/30/35	16,300	150-155	8,500	2,800	430
40/20/40	14,500	146-153	7,700	2,700	417
20/40/40	11,700	165-170	9,500	2,800	434
45/10/45	11,900	139-155	7,200	3,300	420
37.5/12.5/50	10,700	155-168	6,000	3,000	375
25/25/50	10,000	145-150	7,500	2,600	436
17/17/66	11,600	115-120	5,100	2,300	404

latter was employed, determinations of both the yield point and 50% modulus were possible. The procedure was similar to that prescribed in ASTM D 638, except that a jaw separation of 6 in./min. was used. Data are based on the original diameter of the unoriented filament.

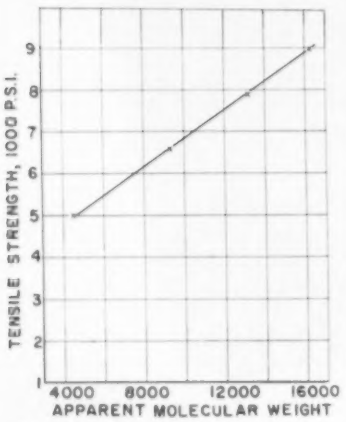

FIG. 7: Tensile strength versus molecular weight for nylon 66/610/pip-10 (35/30/35 composition).

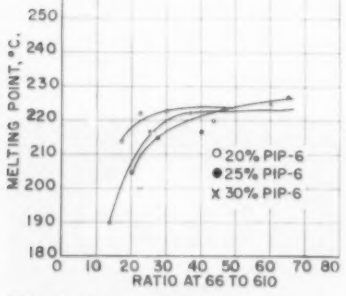

FIG. 8: Melting point versus 66/610 ratio for 66/610/pip-6 polymers.

Melting points were determined on a Fisher melting point block in the presence of air. As reported, they cover the range from initial softening of the crystalline resin to the point of complete liquefaction. Factors which affect the observed softening range, such as the rate of temperature increase, could not be accurately controlled. However, it is felt that the reported values are valid within ± 5° C.

Molecular weights were determined by viscosity measurements of dilute solutions of the polymers in *m*-cresol. The following equation (6) was used:

$$\text{M. W.} = (0.9\eta)\ 1.39 \times 13{,}000$$

While this equation does not yield an absolute molecular weight, an apparent molecular weight is obtained.

A correlation between outdoor weathering and eight days of oven aging at 140° C. has been previously reported for nylon (7). This accelerated test was employed to evaluate the resistance to natural degradation of the various polymers described. Tensile properties were determined after two, four, six, and eight days of oven aging.

Copolymer systems

Several copolymer systems were briefly examined in order to understand the general effect of introducing piperazine into conventional polyamide systems. Polymers of the general type 66/pip-10, 610/pip-10, and 6/pip-10 were prepared. As can be seen from Table I, p. 150, and Figs. 1, p. 152, 2, p. 152, and 3, p. 152, the properties of these copolymers are greatly altered by varying the amount of piperazine. In general, piperazine acts to reduce the tensile strengths, melting points, and yield points. Over the full range of compositions, a minimum point for all three properties occurred at about 80% pip-10.

Terpolymer systems

A terpolymer system, consisting of nylons 66/610/pip-10, was carefully studied. By changing the relative amounts of the various constituents, a wide variation in physical properties was obtained. Correlation of these properties with composition is not as simple as in copolymer systems. However, if the ratio of two components is treated as a constant parameter, certain relationships

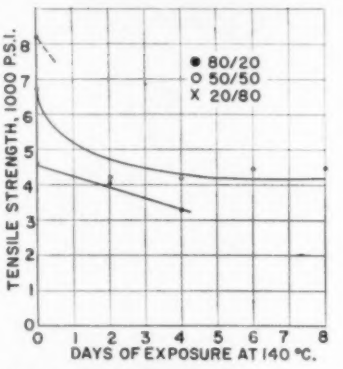

FIG. 9: Effect of heat aging on tensile strength of nylon 610/pip-10 copolymers.

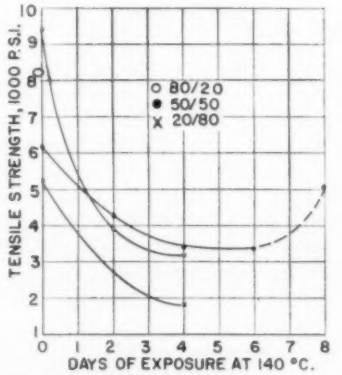

FIG. 10: Effect of heat aging on tensile strength of nylon 66/pip-10 copolymers.

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are observable. For example, using a constant ratio of 66 to 610 of 1.0, increasing the piperazine component resulted in lower yield points and melting points as shown in Fig. 4, p. 152. The effect of varying the concentration of either nylon 66 or 610, while maintaining a constant ratio of the other two components, is illustrated in Fig. 5, p. 152, and Fig. 6, p. 152.

A 35/30/35 composition of nylons 66/610/pip-10 was studied in some detail. One of the chief characteristics of this polymer is a comparatively low tensile strength (5000 to 6000 p.s.i. for most samples). However, a linear relationship between tensile strength and molecular weight was found to exist, as shown in Fig. 7, p. 154. The highest tensile strength obtained was in the range of 8500 p.s.i. for a polymer molecular weight of 16,000.

Similar terpolymer systems were studied, in which the pip-10 was replaced by pip-6. Pip-6 is similar to polyhexamethylene terphthalamide in that homopolymers cannot be prepared employing the usual condensation procedures, since the salt decomposes before melting. Moreover, like polyhexamethylene terphthalamide, pip-6 can be incorporated into mixed polyamide systems without too much difficulty. Replacing pip-10 with pip-6 does not alter the tensile properties of the polymer to any great extent, but does raise the melting point considerably. For example, in the 35/30/35 composition, the melting range is raised from 150 to 155° C. to 185 to 195° C. For this reason, no polymers containing large amounts of pip-6 were prepared for this study.

Properties of the pip-10 and pip-6 nylons are listed in Tables II, p. 154, and III, below, respectively. In order to evaluate these polymers properly, a reverse study was attempted. This consisted in maintaining a constant pip-6 content, while studying the effect of changing the ratio of 66 to 610. Although a complete range of values is not available, the general effect seems to be an elevation of the melting point with increasing 66 content. Surprisingly, the parameters of pip-6 concentration do not fall into sequence, as shown in Fig. 8, p. 154. In this case, architectural dissymmetries, which are often very difficult to predict, may account for the irregularity.

Conclusions

In general, polyamides based on a multiplicity of ingredients would be expected to have a lower degree of crystalline order than those based on single diamine and a single diacid, since it would be more difficult for the molecules of various lengths and configurations to line up in the proper spatial configuration. It follows that the use of a secondary amine, such as piperazine, might produce even a lower degree of crystallinity, because in this special case hydrogen bonding, which contributes to the crystalline forces, would be absent. Copolymers containing polymers based on piperazine would be expected to have corresponding materials not containing this heterocyclic amine. Examination of such data for nylon 66 as compared with that for nylon 66/610 and nylon 66/pip-10 supports these expectations. In general, the terpolymer systems also behaved as predicted, with one exception. The combination, nylon 66/610/pip-6, exhibited a wide range of melting points as the piperazine ratio was varied, but without any corresponding variation in tensile strength.

The data presented in this paper support the observations of Hamilton and Questel (8) that nylon composition 66/610/pip-10 exhibited the greatest stability when the components were present in nearly equal proportions. It was also ascertained that this behavior was *(To page 206)*

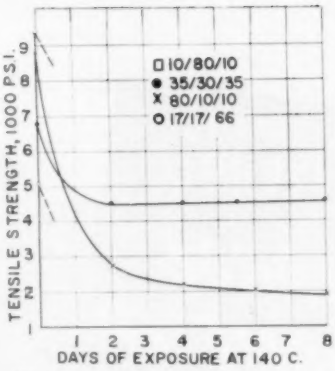

FIG. 11: Effect of heat aging on tensile strength of nylon 66/610/pip-10 terpolymers.

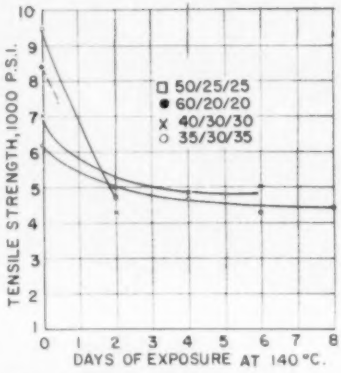

FIG. 12: Effect of heat aging on tensile strength of nylon 66/610/pip-6 terpolymers.

Table III: Physical properties of the nylon 66/610/Pip-6 system

Composition by weight	*Apparent molecular weight*	*Melting point*	*Tensile strength*	*Yield point*	*Elongation*	*Stress at 0.5 strain*
%		°C.	p.s.i.	p.s.i.	%	p.s.i.
50/30/20	10,400	212-216	9,000	3,200	370	2,800
55/25/20	15,900	222-225	5,100	4,650	250	3,000
60/20/20	14,300	218-228	8,400	3,450	395	2,850
65/15/20	20,100	220	8,200	4,000	350	3,000
50/25/25	16,500	200-210	9,500	3,000	400	2,500
55/20/25	11,100	210-220	9,850	3,200	400	2,650
60/15/25	4,300	215-220	9,100	3,000	410	2,500
65/10/25	13,700	225-230	10,600	3,600	425	3,100
50/20/30	13,800	215-220	7,800	3,100	385	2,600
55/15/30	9,700	220-225	8,050	2,350	360	2,350
60/10/30	10,300	220-230	10,400	3,400	370	3,300
40/30/30	12,900	185-195	7,100	3,000	400	2,700
35/30/35	12,600	185-195	6,200	2,800	400	—

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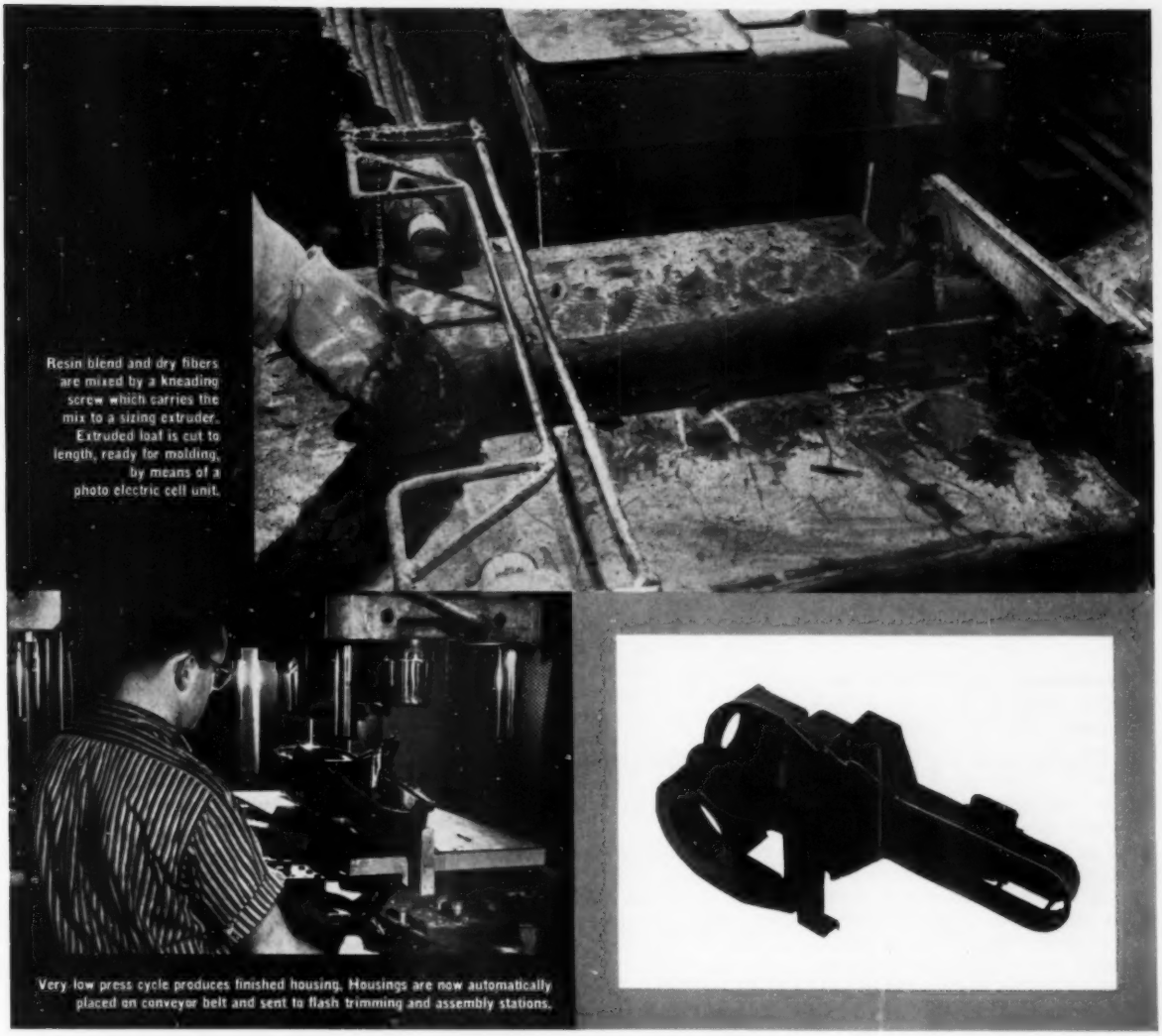

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"Welding of Plastics," by *J. Alex Neumann and Frank J. Bockhoff.*

Published in 1959 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 279 pages. Price: $7.25.

This book not only deals very completely with hot-gas welding, but also covers the newer methods of welding with friction, heated tools, and induction-heated inserts. There is a strong chapter on designing welded plastic fabrications, strengthened by tables of service ratings of weldable plastics in chemical service. Little reference has been made to published literature, and the wide experience of American Agile and Du Pont seem to have been the main sources of information. The book's up-to-dateness is indicated by its coverage of Teflon FEP resin, polypropylene, and other new resins.—*J.F.C.*

"Handbook of Chemical Microscopy," Vol. I, Third Ed., by *Emile Monnin Chamot and Clyde Walter Mason.*

Published in 1958 by John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. 502 pages. Price $14.00.

This scholarly work has been brought up to date with new material on electron microscopy, particle size, and aggregates, all topics of interest to the student of microstructure of plastics. The chapter on photomicrography will be extremely helpful. Hundreds of literature references lead to further information on all aspects of the subject.—*J.F.C.*

Formaldehyde. "The Salient Characteristics of Formaldehyde" gives the nomenclature, history, preparation, characteristics, aqueous solutions, chemical nature, etc., of formaldehyde. 4 pages. "Engineering, Safety, and Control for the Proper Handling of Formaldehyde." 4 pages. *The Borden Chemical Co., 350 Madison Ave., New York 17, N. Y.*

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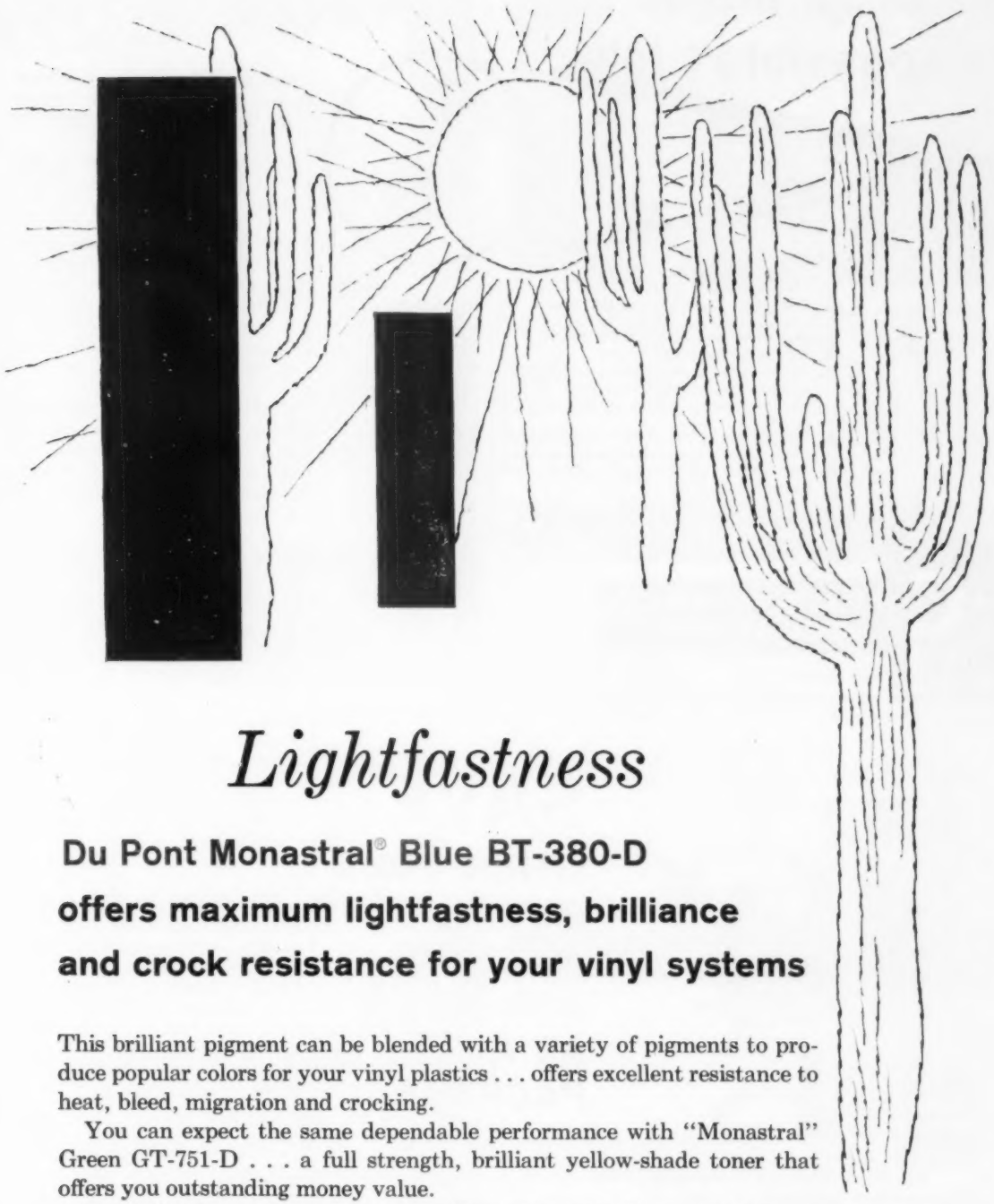

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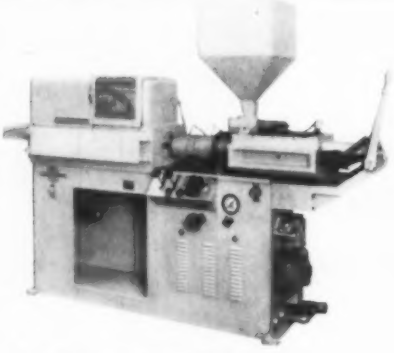

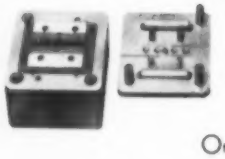

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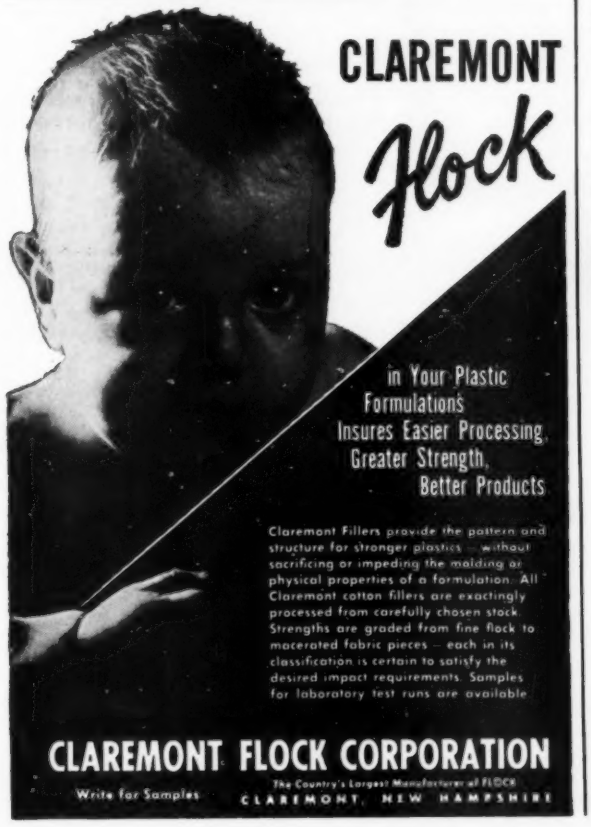

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Ion exchange. J. C. H. Hwa (to Rohm & Haas). U. S. 2,862,892-3-4, Dec. 2. Ion-exchange resins.

Polymerization. P. W. Cummings, Jr. and A. O. Mogensen (to American Cyanamid). U. S. 2,862,895, Dec. 2. Recovering polymers from by-products.

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Resin. T. J. Suen and Y. Jen (to American Cyanamid). U. S. 2,862,-901, Dec. 2. Solution of amino-aldehyde resin and a polymer having carboxamide groups.

Polymerization. J. E. Pritchard (to Phillips). U. S. 2,862,902, Dec. 2. Polymerization of 3-vinylpyridines.

Resin. D. H. Mullins (to Union Carbide). U. S. 2,862,904, Dec. 2. Polyvinyl chloride plasticizer.

Resin. F. W. Banes, A. H. Gleason, and J. F. Nelson (to Esso). U. S. 2,862,905, Dec. 2. Thermosetting resin from sodium polymerized butadiene.

Polymerization. A. Stein and R. M. Walter (to Monsanto). U. S. 2,862,-906-7, Dec. 2. Polymerization of vinylidene aromatic hydrocarbons.

Resins. W. D. Jones, H. P. Marshall, R. E. Davies, and W. D. Paist (to Celanese). U. S. 2,862,908, Dec. 2. Polyvinyl acetals.

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Resins. L. M. Higashi and R. A. Jarui (to Monsanto). U. S. 2,862,910, Dec. 2. Liquid phenolic resins.

Copolymer. J. A. Blanchette (to Monsanto). U. S. 2,862,911, Dec. 2. Alkyl vinyl ketone-styrene copolymer.

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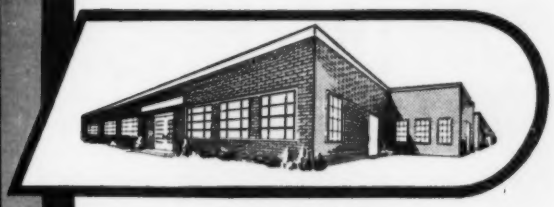

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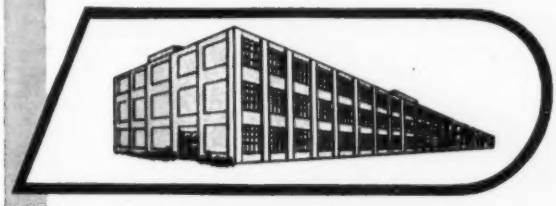

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2,862,917, Dec. 2. Polymerization of ethylene.

Polymers. J. N. Short, A. C. Rothlisberger, and A. E. Follett (to Phillips). U. S. 2,863,488, Dec. 9. Polymers from carbamates of aryl-substituted butenyl alcohols.

Polymers. J. C. Hillyer (to Phillips). U. S. 2,863,784, Dec. 9. Hydroxylated conjugated diolefin polymers.

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Resins. P. Robitschek and C. T. Bean (to Hooker). U. S. 2,863,794-5, Dec. 9. Polymerizable mixture of vinylidene monomer and unsaturated polyester.

Resin. F. A. Bonzagni (to Monsanto). U. S. 2,863,842, Dec. 9. Sulfite-modified melamine resin.

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Polymers. P. Robitschek and C. T. Bean (to Hooker). U. S. 2,863,848, Dec. 9. Polymers containing hexachlorocyclopentadiene.

Molding compositions. J. W. L. Fordham (to Monsanto). U. S. 2,863,849, Dec. 9. Butadiene-styrene copolymer-modified polystyrene.

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Stabilizer. J. L. O'Brien (to Rohm & Haas). U. S. 2,863,851, Dec. 9. Stabilizer for polyacrylic ester resin.

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Polyamide. W. Costain, N. Fletcher, and B. J. Habgood (to Imperial Chemical). U. S. 2,863,857, Dec. 9. Trimesic acid-modified polyamide.

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Resins. E. C. Shokal and R. W. H. Tess (to Shell). U. S. 2,864,804, Dec. 16. Hydroxy-substituted allylic ether derivatives.

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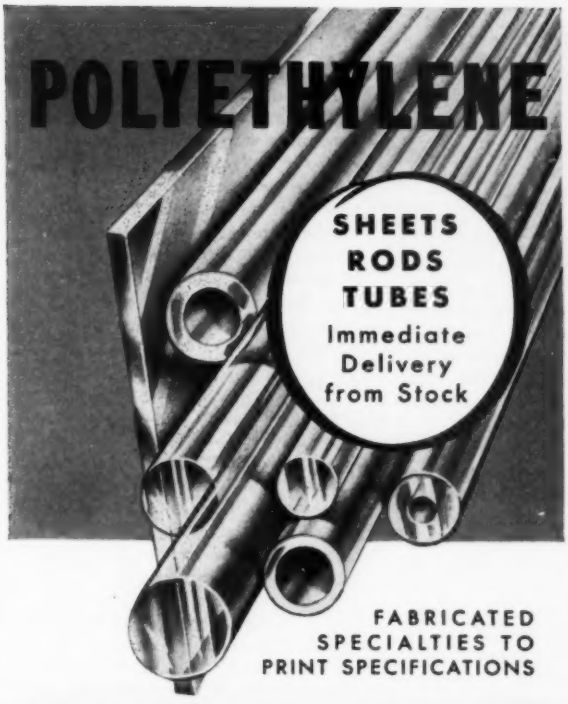

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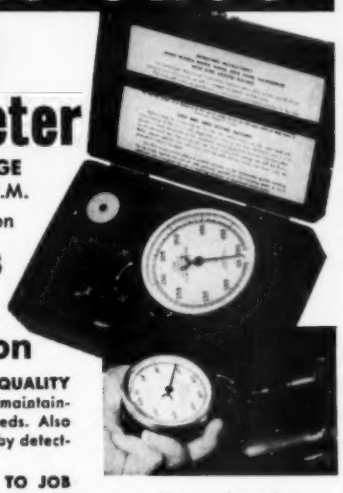

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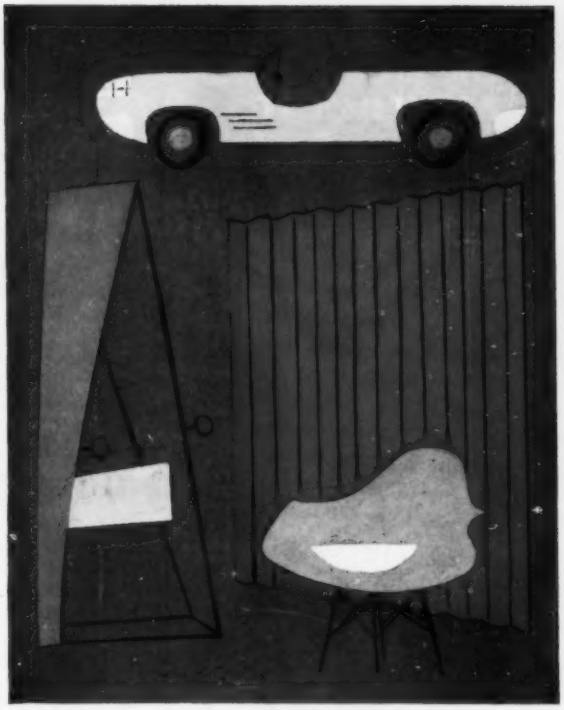

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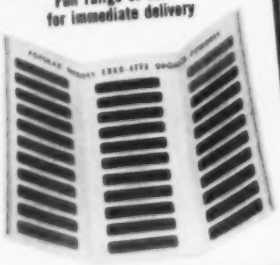

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Plastics Digest

(*From page 54*)

a covering of plastic foam produces a large reduction in the peak pressures experienced by the striking object and distributes the force over a larger surface area.

Properties

Thermal embrittlement of stressed polyethylene. J. H. Heiss and V. L. Lanza. Wire and Wire Products *33*, 1182-7, 1285 (Oct. 1958). Three separate phenomena can initiate brittle failure in polyethylene (PE). The mechanisms involved are oxidative, environmental, and thermal. An applied strain results in an elastic dislocation of crystallites from their low energy state into a higher energy arrangement. The restoration forces overcome the viscous drag and points of inherent weakness in the bulk material are left which leads to brittle failure. The mechanism is thermal in nature and is temperature-time dependent. Environmental stress-cracking is apparently caused by a substitution of intermolecular forces in PE by the contact medium, which allows the molecules to separate. High-density PE is more susceptible to thermal embrittlement than the low-density materials, which are not greatly affected. The use of high-density PE in wire and cable applications is, at present questionable.

Photoelastic behavior of cross-linked polymers. Z. Tuji, K. Kawata, and I. Hori. Brit. J. Appl. Phys. *9*, 173-78 (1958). The photoelastic and mechanical properties of phenolic resin, epoxy resin, diallyl phthalate, styrene-divinylbenzene copolymers, and styrene-polyester copolymer were studied over a broad temperature range. A large change of the stress-optical coefficient was observed in the glassy transition region; at temperatures above that region cross-linked polymers show photoelastic behavior corresponding to nearly perfect entropy-elasticity. Addition polymerization polymers were preferable to condensation polymers as materials for the stress-freezing method.

Creep of low density polythene. E. A. W. Hoff, P. L. Clegg, and K. Sherrard-Smith. Brit. Plastics *31*, 384-89 (Sept. 1958). Tensile creep experiments on monofilaments and circumferential creep studies on polyethylene (PE) tubing were made from 20 to 80° C. and at various stresses. Data were compiled by a "master-curve" technique, in an attempt to predict long-term creep and working pressures of PE tubing. Calculated strains obtained by this technique on experiments of a few days duration were in favorable agreement with data obtained over a period of 18 months. Preliminary results show that previous thermal history of the material is important in the determination of long-term service life. Considerable variations in the amount of strain produced by hoop stress in the tube and tensile stress in the monofilament may be present.

Testing

Low temperature cracking test for plasticized PVC. D. Wor ald. Brit. Plastics *31*, 392-95, 405 (ept. 1958). A test method is describea for low temperature flex cracking of unsupported PVC sheeting. Tests were conducted at closely controlled temperatures in the range of 0° to −15° C. Specimens were continuously cycled until failure by holding them in a folded position for about 25 sec., and an unfolded position for about 5 sec., simulating the use of PVC in women's handbags. The data indicated that several conditions could influence the reliability of the test, including: the velocity of folding, regulated by electrical current through a solenoid; the diameter of the fold; and the plasticizer content and type.

Publishers' addresses

Adhesives Age: Palmerton Publishing Co., Inc., 101 W. 31st St., New York 1, N. Y.

British Journal of Applied Physics: Institute of Physics, 47 Belgrave Square, London S.W. 1, England.

British Plastics: Iliffe and Sons, Ltd., Dorset House, Stamford St., London S. E. 1, England.

Canadian Journal of Chemistry: National Research Council, Sussex St. 2, Ottawa, Ontario, Canada.

Chemical and Engineering News: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Chemical Week: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Kunststoffe: Karl Hanser Verlag, Leonhard-Eck-Strasse 7, Munich 27, Germany.

Mechanical Engineering: American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Physics and Chemistry of Solids: Pergamon Press, 122 E. 55th St., New York 22, N. Y.

Plastics (London): Temple Press, Ltd., Bowling Greene Lane, London E. C. 1, England.

Plastics Institute Transactions: The Plastics Institute, 6 Mandeville Place, London W. 1, England.

Plastics Technology: Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.

Plastics World: Cleworth Publishing Co., Inc., 342 Madison Ave., New York, N. Y.

Product Engineering: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.

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(From page 58)

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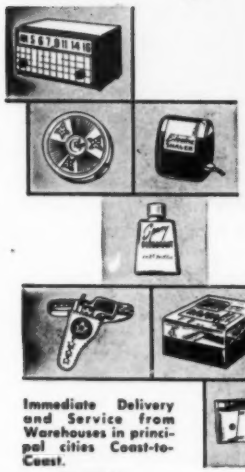

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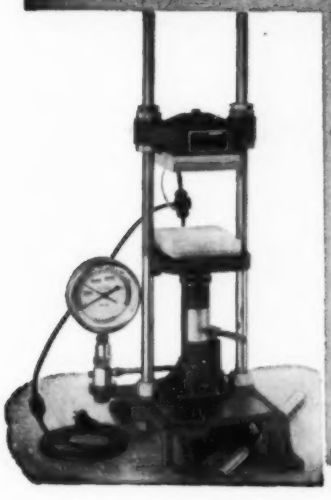

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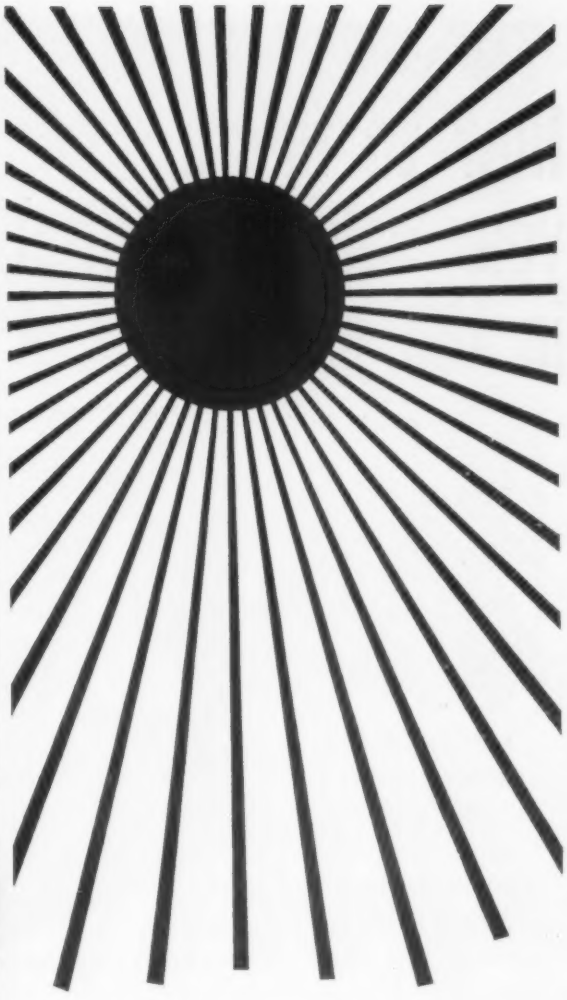

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supplied by Union Carbide Plastics Co. as the exterior laminate for steel slats. In manufacturing the door, individual steel slats are hung, proportionately spaced, in a row. Then the film is laminated to both sides of each slat and to itself between each panel, using specialized heat sealing equipment. The vinyl-to-vinyl lamination serves as a hinge between the slats. Choice of the film was based on low material cost and ease of lamination. The door folds to about 5% of extended width and retails for about $10. Sizes are 38 by 80, 32 by 80, and 38 by 96 inches.

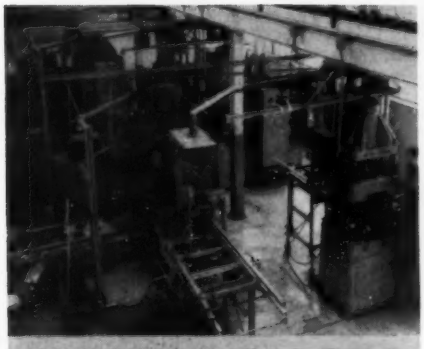
Double bucket

Molded of high-impact polystyrene, a new take-apart bucket serves a double purpose in one form and an entirely different objective in another.

The bucket halves are identical moldings, produced by Brittain Products Co., Cuyahoga Falls, Ohio, using Koppers material. When two of the moldings are assembled and held together by a molded handle, the combination provides a handy bucket for general cleaning chores; soapy water is kept in one side and rinse water in the other. With the handle, the combination retails at $2.98 in either red or white.

One half of the bucket, with a special wire handle, retails at $1.49 for use as a "Litter-Buc" in automobiles to hold paper scraps, tissues, candy wraps, etc.—END

Cutting mold set-up time by more than 50%



BAKER Presses operating in General Purpose Control Department, Bloomington, Illinois plant.

BAKER Automatic Molding Machines saved more than half the former mold set-up time in General Electric's General Purpose Control Department at Bloomington, Illinois.

BAKER presses are versatile. Cycles are set with a simple screw adjustment cam. Feeding is accurately and simply adjusted for various molds.

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STANDARD AND SPECIAL DRILLING AND TAPPING MACHINES • AUTOMATIC BAR MACHINES

Decorating

(From pp. 91-96)

in relief on the front of the piece, new silicone rubber dies are now available to permit the letters to be hot stamped with leaf. Similarly, in applications where the plastic piece is clear and the lettering has been molded-in in reverse on the rear surface, the top of the letters can be hot stamped from the back (using the new silicone rubber dies) to give interesting three-dimensional effects.

Labels and decalcomania

Although not new to the plastics industry, there has been a recent spurt in activity in these decorating media that indicates their growing importance. The reasons behind this spurt appear to be threefold.

1) Excitement aroused by the introduction of the Therimage transfer labeling process by Dennison Mfg. Co., Framingham, Mass. (see p. 95). Machines have already been developed to use the technique to decorate polyethylene bottles in up to 4 colors at speeds ranging from 50 to 100 units per minute. The polyethylene bottles can be decorated on two sides with one feeding or by setting up two machines in tandem. Round bottles can also be decorated the circumference of the bottle, allowing space for mold seams, with one feeding.

Cost savings with the process are claimed to be high. According to Dennison, decorating bottles by silk screening cost about $7 per pass for a thousand bottles. At this rate, a 4-color job on the face and two colors on the reverse side of a bottle would cost about $40 per thousand to decorate. By transfer labeling, the same decoration can be performed at the rate of $10 per thousand.

2) The recent appearance of high-speed machines for applying labels. New Jersey Machine Corp., for example, makes available two machines for applying labels to plastics items. Both machines use a suction label handling system. One of the units passes the label over a glue roll on the way to the item to be handled; the other heats the label as it is being delivered to the object so that the heat activates a precoating of thermoplastic surface on the back side of the label. The labels can be applied at speeds of about 60 per min. and have already been adopted by several manufacturers of plastics toys and novelties.

3) New types of labels based on new materials. W. H. Brady Co., Milwaukee, Wis., for example, offers a label printed on Mylar polyester film that has outstanding abrasion resistance, weatherability, and can take temperature ranges from −60 to 300° F. The Park Nameplate Co., Inc., Flushing, N. Y., offers colored anodized aluminum plates for decorating a variety of plastic products. Both labels are backed with a pressure-sensitive adhesive. The Meyercord Co., Chicago, Ill., supplies a series of pressure-sensitive labels to be applied as a decoration to a line of reinforced plastics model automobiles. Tompkins' Label Service, Philadelphia, Pa., reports two further case studies: 1) A

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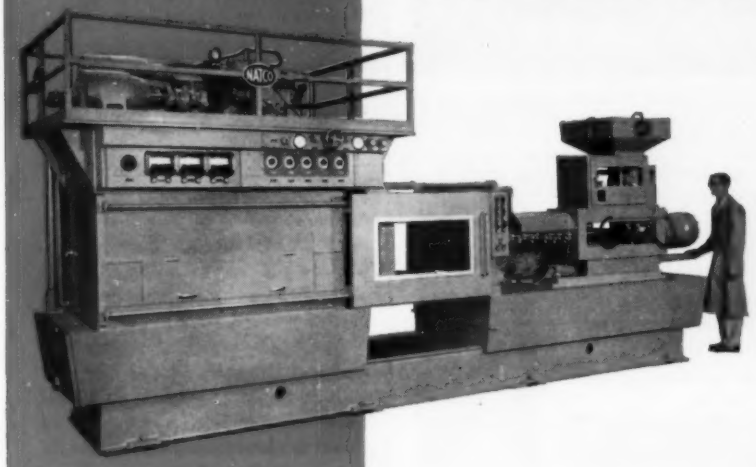

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PLATEN SIZE	33″ x 33″
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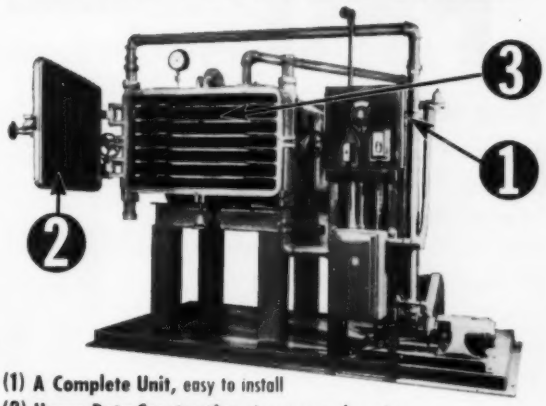

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label simulating stained glass windows used by a toy manufacturer on a model church building kit molded of styrene; and 2) silver foil labels applied to the window area of plastic model boats. By reflecting light, the silver foil gives the appearance of a glass window.

Miscellaneous decoration

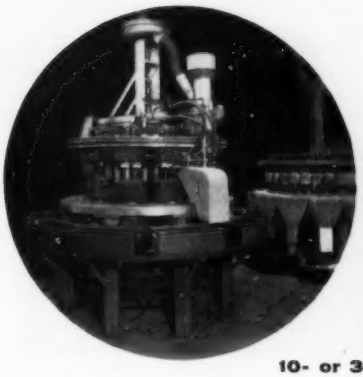
Advances in the technique of molded-in foil decorations have been aimed at applying the technique to parts of more complex contour and design than simple, shallow dinnerware. Various novelties and cosmetics packages look as if they will be first on the list.

Although vacuum metallizing still remains the most popular technique for applying a metal finish to plastics, a number of other methods are also currently in use. Anchor Plastics Co., Long Island City, N. Y., for one, has developed a technique for extruding a metal foil inside of a clear butyrate strip. The finished effect is that of a metal trim.

In another variation, Planet Plating Co., Inc., Brooklyn, N. Y., makes use of a barrel plating technique in which a thin film of silver is deposited on the surface of the plastic to make it electrically conductive. Between 2 and 5 mils of copper are then plated on top of the silver and the plastic is polished in the burnishing barrels by a mixture of steel shot and lubricating soap. Barrel plating is recommended for smaller parts —generally up to 2½ in.—and has thus far been used to apply a rich finish to novelties, buttons, toys, and advertising specialties.

From G.M.C. Process Corp., Bel-Ve-Dere Div., New York, N. Y., has come a technique for applying a variety of openwork or "filgree" patterns to plastics by electrolytically laying down a layer of sterling silver. This technique has been refined to the point where personalized names can be worked into the lattice designs.

A number of methods are also available for molding or extruding parts with more than one color. Borden Hively Co., Columbus, Ohio, and Thermoplastic Processes, Inc., Stirling, N. J., are among those who can extrude



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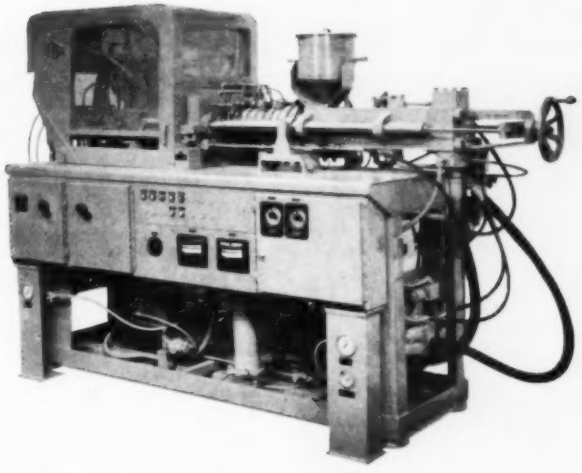

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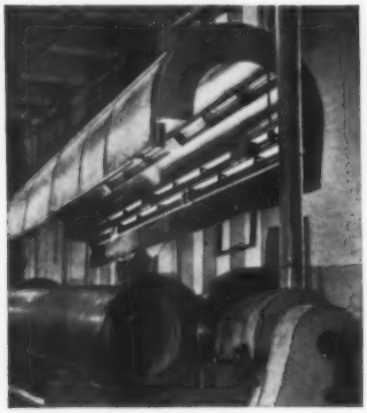
HOW CHROMALOX ELECTRIC HEAT helps make it...and make it work

...the U.S. Navy's new Mark 32 fibre-glass torpedo launcher

From its unlikely beginning as a fibre-glass mat . . . to its successful operation in sub-freezing sea spray . . . the Mark 32 torpedo launcher testifies to the versatility and dependability of Chromalox electric heat. Designed and built by Apex Reinforced Plastics, division of White Sewing Machine Corp., this lightweight, corrosion-resistant launcher is now in service on Navy destroyer escorts.

Early in production, a Chromalox-heated hood is used in centrifugal molding of the launcher tubes.



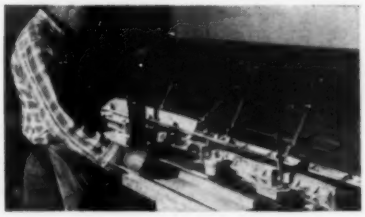
First, a rolled fibre-glass mat is placed inside the mandrel, which is then engaged in spinning motion at 800 rpm. After thermosetting resin has been sprayed into the mandrel, the hood is lowered into position for heat curing. The Chromalox type RAD Far-Infrared Heaters have a total capacity of 36,600 watts, and reach approximately 200°F. in about 45 minutes. The hood remains on a total of about 3½ hours, throughout the spinning operation.

Before final assembly, each tube must have steel "nut bars" and "guide bars" cemented to its interior. (Nut bars connect the three tubes into one assembly; guide bars guide torpedoes into the launcher tube.) After these parts are cemented in place, two Chromalox Tubular Heaters wired in series set the cement.

Mounted in a frame which holds them in the center of the tube for its entire length, the 240-volt, 2750-watt heaters are controlled by a Chromalox type AR Thermostat. A small fan attached to the end cap circulates heat within the tube and eliminates condensation.

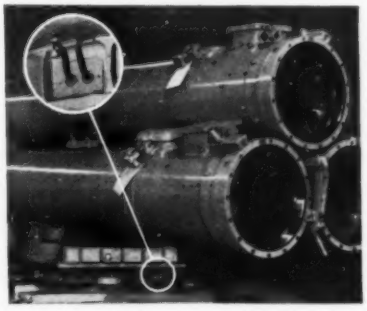
Next, four plastic quadrants are bolted to the tube interior, forming a liner to accommodate 12¾-inch torpedoes. To each quadrant are affixed two 101-inch Chromalox Flexible Woven Heaters.

After resin has been applied to the two channels in each quadrant, heaters are laid in place as shown below. The leads are then connected



to a power outlet and the heaters set the cement which bonds them in place. In action, these heaters maintain a protective 50°F. minimum temperature for the torpedo.

The closeup below shows two leads of a circular Chromalox Tubular Heater clamped in a groove around the launcher's swivel base. To prevent formation of ice in the joint between fixed and rotating parts of the base, this heater comes on automatically when the temperature drops below 50°F.



Plastic bottles, containing air at 2000 psi, provide pneumatic force to launch the torpedoes. Fabrication of these bottles, by the unique Apex filament winding process, involves still another Chromalox Heat application. After the plastic bottle has been formed around a Cerro-alloy ball mold, the alloy must be melted from the bottle's interior. Four sets of Chromalox Strip Heater Bands and a Chromalox Ring Heater provide booster heat on the steam-heated vat used for this purpose.

Perhaps one of these heaters, or one of the 15,000 other types, sizes and ratings of Chromalox Heaters can answer your need for heat. For personal assistance and specific recommendations, *Call your Chromalox Man for the Answers.* He's listed at the right. 7787

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shapes with stripes in contrasting colors. J. P. Gits Molding Corp., Chicago, Ill., as another example, uses a double shot molding technique (see p. 92).

Armstrong Cork Co., Lancaster, Pa., has developed a new technique for molding debossed designs into the sides of compression molded caps. Designs that can be handled in this way include names, trademarks, floral designs, etc.—in contrast to previous techniques which limited decoration on the skirts of plastics caps to a vertical direction.

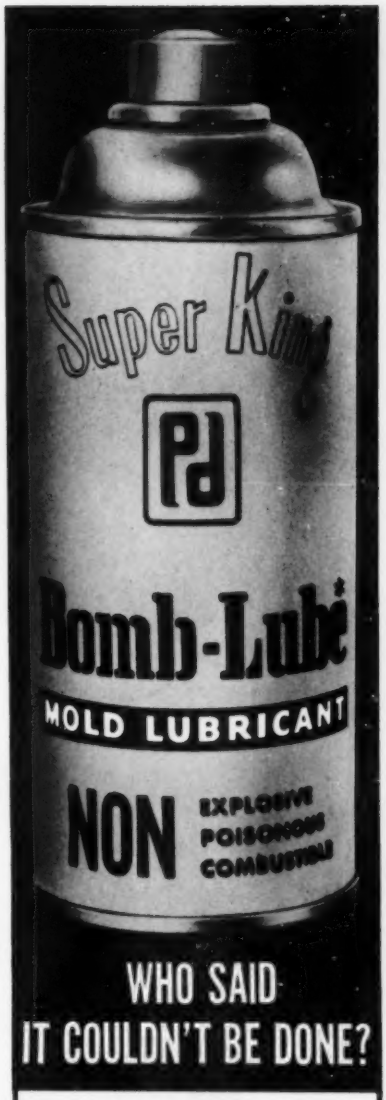
Plastomatic Corp., Malvern, Pa., uses an elaborate three-dimensional design in which molded styrene figures in contrasting colors are cemented to the face of styrene housewares in much the same way as a conventional applique would be used.

And several molders of expandable polystyrene have put unusual effects to work on their products. La Della Plastics, Inc., Fox Lake, Wis., flocks its expandable styrene foam toy banks to give the appearance of a "fuzzy" teddy bear (see p. 93); Frank Plastics Corp., Detroit, Mich., adheres a sheet of embossed, printed vinyl to its expandable styrene ice buckets; and Polly Plastics, Inc., Cleveland, Ohio, uses black applique overlays on its expandable styrene planters.

Designing the part for plastics

Since decoration is still considered as a subsidiary or finishing operation, it is often overlooked when initially planning mold design. Only when the piece is finally ready for decoration does it become apparent that something as simple as a change in plane between adjacent color areas to provide a paint stop might have been translated into important economies.

A good case study of how mold design can be used to facilitate the decorating operation is offered by the dial for a Zenith all-transistor trans-oceanic radio molded of Plexiglas acrylic by Erie Plastics Div., Erie Resistor Corp., Erie, Pa. (see p. 91). Erie, of course, also did the decorating of the piece and as such designed the piece to facilitate ease of stamping, shielding for painting,



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and plating operations. Although it is molded as one piece, by using all three decorating techniques, it gives the appearance of three separate parts—a metal frame or bezel, a dial, and a clear window.

Most of the lettering and the dial numbers are first hot stamped on the rear of the acrylic piece. To facilitate the stamping, the piece was designed so that all letters and numbers appear on flat surfaces. Care was taken to insure clearance for the stamp and the stamping tape drag on all vertical walls near the stamped area.

The word "Zenith" and the rectangular area which functions as the clear window are then masked off and the entire rear surface background is sprayed in black. The mask is then removed from the word "Zenith" and a gold tint is sprayed onto this area. The front surface is then suitably shielded and the entire unit is metallized. The word "Zenith" comes out in gold and the bezel frame around the front simulates a chrome-plated metal casting.

To facilitate shielding during this operation, a shielding step was designed into the front face of the piece just inside the frame area that is front surface metallized. This enables Erie to shield and then spray on a strip coat over the window area to serve as a permanent protection through all the finishing operations. (For full details on spray-on coatings, see "High-speed masking process," MPL, Oct. 1958, p. 123.)

Similarly, a vertical wall with sharp corners for good spray shield shut-off was designed into the rear of the piece to keep the window area clear during the spray black operation.

Finally, all front surface corners, especially those that are top surface metallized are radiused to eliminate a wear point on sharp corners. It was interesting to note that by using top surface metallizing, Erie was able to design the part so that mounting lugs could be molded in around the edges of the piece. Metallization, of course, effectively hides the lugs.

Other case studies

Kent Plastics Corp., Evansville, Ind., offers an interesting case study for a molded acrylic plaque

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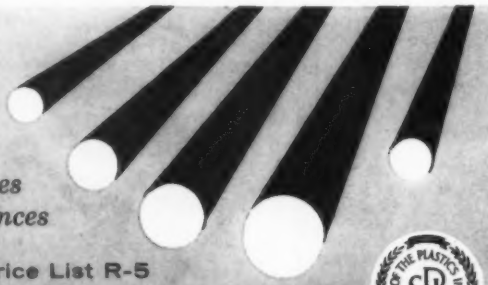

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used by the Shell Oil Co. as a decorative facing for the gasoline pumps used in their service stations.

As reported by Kent, the part was molded in a three-plate type mold using center gating. Since the piece is molded of clear Plexiglas acrylic, all decorating is done on the rear surface and the operation sequence is as follows:

1) Mold; 2) Spray on the red; 3) Spray on the white; 4) Spray on the yellow; 5) Spray on clear gold; 6) Metallize; 7) Scrape edge; 8) Spray satin gold; 9) Spray on backcoat; 10) Drill mounting holes; 11) Spray on sealer coat; 12) Sand gate; 13) Buff; 14) Inspect; and 15) Pack ready for shipment.

Obviously, of course, masks are used during each of the spraying and metallizing operations to shield off those areas not to be colored. All during molding, the production department was especially careful not to handle the part nor to have any direct contact by fingers with the surface to be finished.

All finishes were applied by a semi-automatic spray machine to insure uniformity of paint coverage and economical application.

All parts were normalized prior to finishing to relieve residual strains from molding. Special manufacturing care was also taken to prevent any of the metallized portions from being exposed in the finished product. This was necessary to prevent electrolytic corrosive action from taking place when the plaques are assembled to the pumps. Special equipment also had to be developed for applying the clear gold coating so as to ensure uniformity of color over this large an area.

An additional sealer coat was applied over the regular backcoat for increased longevity and special finishes on both the base coat and sealer coat were developed to maintain the same coefficient of expansion as in the clear gold lacquer and thereby prevent frosting of the metallized sections.

Another unusual display that puts to work several different decorating techniques is offered in an illuminated sign molded of Monsanto's styrene by Anfinsen Plastic Products Molding Co.,

Your Modern Plastics Encyclopedia Issue contains 1,218 pages of answers to questions like these:

"In *designing* plastic products, what factors govern the choice of surface decoration? Which features give added impact strength to thin edges? What can be done to correct warpage?"

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"How deeply have *Japanese* plastic materials penetrated the American market?"

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"What *special techniques* and formulations have been developed for the foaming of reaction-type phenolic resins?"

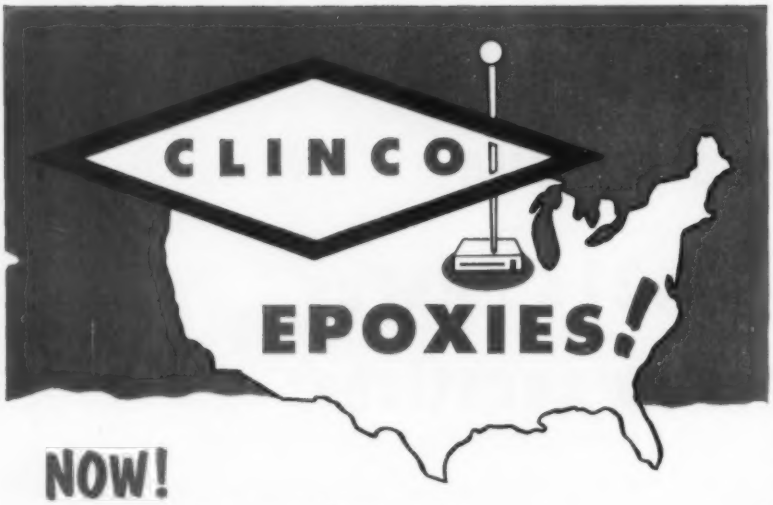
"What *printing method* is most commonly used in producing printed packaging films? And why is there a swing toward this process among decorators of light-gage polyethylene?"

"In reinforced plastics, what are the pros and cons of *matched-metal die molding?*"

"Where can you purchase electronic heat sealing machines?"

"Who are some custom molders and extruders around Los Angeles?"

What's your question?



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Aurora, Ill., for Thomas A. Schutz Co., Inc., Morton Grove, Ill. The main face panel of the sign is injection molded of general-purpose styrene and silk screened with translucent paints. The face plate, bezels, ribbons, and compass rose (the sign is shaped like a compass) are also injection molded of the same material but are vacuum metallized in gold. The letters of the cardinal compass points are injection molded separately in contrasting color and bonded in position. A white medium-impact styrene is used to mold the retaining ring and light baffle, which includes a metal bearing insert. The light "piping" spider is molded in four sections of static dissipating styrene crystal. Finally, scintillating color changes are affected in the spider by a printed revolving wheel of cellulose acetate sheet.

Polyethylene bottles

Another example of the new skills being developed to meet specialized problems is offered by Multicraft, Inc., Chicago, Ill., custom decorators. The job in point involved the screening of a 1-gal., thin-wall polyethylene bottle weighing under 4 ounces. The bottle required an injection of air into the hollow interior to fill out the shape of the piece and give it the necessary rigidity for quality screening. A positive displacement air pump operated by an air cylinder was built to effect this. The air pump was attached to the screening machine and the air was forced into the bottle and synchronized with the screening as a single operation. A screening machine that would rotate a cylinder with a 20-in. circumference and could handle a silk screen 26 in. long was used. Special rollers and the necessary fixtures to hold the bottle in position once it was filled with air also had to be designed.

Dispenser housings

A really unusual decorating job was effected by J. P. Gits Molding Corp., Chicago, Ill., for a Coca-Cola dispenser they molded for the Dole Valve Co. (see p. 92). Designer for the job was Claire Hodgeman.

There are seven injection molds used in making this part—the

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cover, side panels, and end panels. The side panels, molded of Implex B modified acrylic, all carry the flowing script letters of the trade name—in white on a red background. The white letters project out about ⅛ in. from the surface to give a true three-dimensional effect. This part is produced by the double-shot molding method which makes the two-color part appear as a single piece.

The end panels are also molded of acrylic. The top half is molded in a cool green with a subdued decorative design. Molded letters, in white and red, are mounted on this panel so that they stand out in relief. A protective cover molded of acrylic seals this section from dirt and provides a smooth surface for easy cleaning. The lower portion of this panel is spray painted on the rear to carry out the design motif.

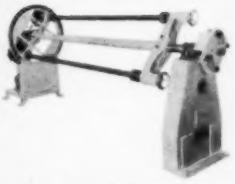
Most of this lower surface is sprayed with an opaque white paint except for the words, "Refresh Yourself," which are in pastel green, and several rows of decorative dots. These dots are molded as depressions in the rear of the acrylic and are gold metallized. Since this molding is in two different vertical planes—the top transparent section is set back slightly from the white lower portion—the two planes are brought together with a short radius curve which is also gold metallized to give the effect of a metal bar across the panel.

An unusual automotive application involves a combination of reflectorizing and vacuum metallizing used in the armrest for the 1959 Chevrolet Impala. The part mounts vertically at the back of the armrest so that when the door is open, the reflective area of the piece catches the headlights of approaching cars—an important safety feature (see p. 92).

The component is molded of transparent red Forticel cellulose propionate by Michigan Plastic Products, Inc., Grand Haven, Mich. A concealed lug having three cored holes provides attachment to the armrest. Finishing operations, handled by Thierica Studio, Grand Rapids, Mich., involves application of a reflective material to the back of the

Dilts

PLASTIC WINDERS and COOLING TRAIN



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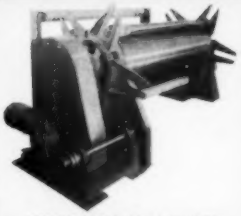

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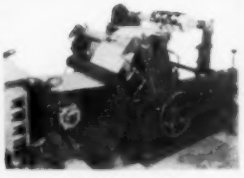

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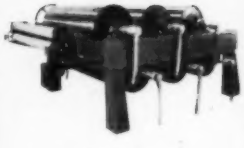

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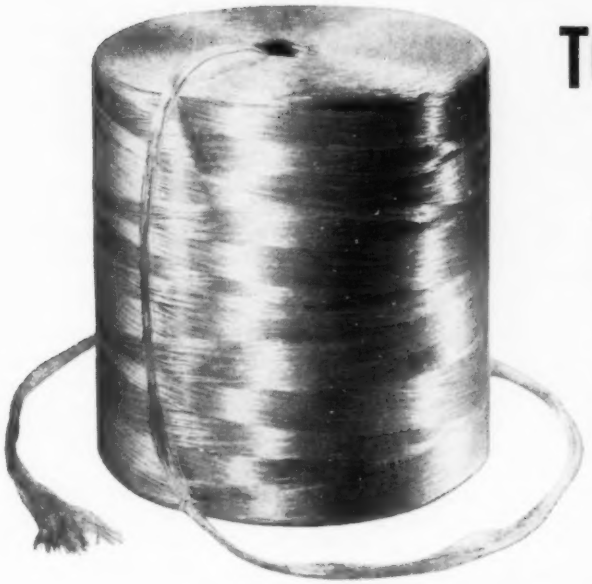

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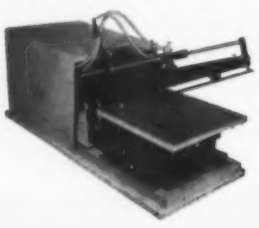

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In decorating, a strippable masking coat is first sprayed on the front of the part in the recessed area to be reflectorized. Scotchlite medallion compound, produced by Minnesota Mining & Mfg. Co. expressly for the automotive industry, is sprayed in a thin layer on the back. This material is described as a suspension of special reflex-reflective glass beads in a solvent dispersed vehicle. After drying, the parts are mounted on revolving racks and loaded into a vacuum coating unit where unmasked areas receive a bright metallic coating. Application of back-up paint to seal the reflective beads and stripping off of the mask protecting the reflective area completes the part.

Decorating on the rise

There can be no question about the importance of decoration to the plastics industry today. Many custom molders have already started to expand this service for their customers—with profitable results. According to one custom molder interviewed in the course of this survey: "Because we do offer this specialization in decoration, we feel we can ask for—and we usually get—higher prices. So important has decorating now become to us, that today over 60% of our products are decorated."

At the same time, decorating equipment has also started to go into end-user's plants—and still the business is big enough to support a whole raft of companies who specialize only in the decorating of plastics.

With current advances in the field, decorating techniques are expected to go still further. One molder put it this way: "Despite rising labor costs which have affected most of our departments, the decorating operation, thanks to advances in machinery design, is probably the only one in my shop I can still perform more efficiently and for less money than it cost me to do five years ago."

Add to this the fact that decorating makes it possible to simulate more expensive materials (e.g., metals) and costly assembly jobs (e.g., a one-piece acrylic

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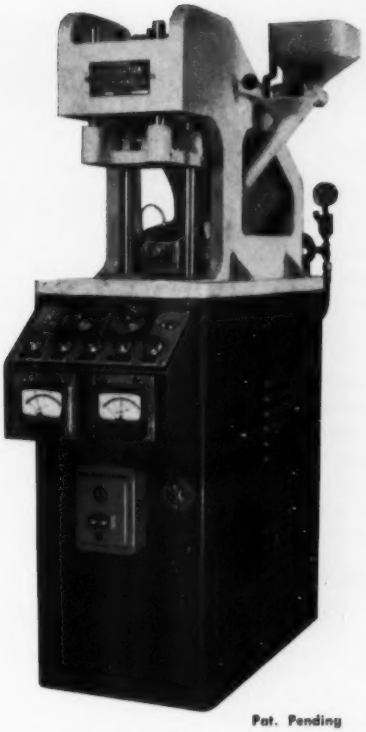
Plastic Injection Molding Machines

Typical example of insert molding on "Eldorado" MINI-JECTOR. *Left*—Close up of mold in open position. Note unobstructed access to mold area. *Center*—Close up of mold in closed position. *Right*—Cycle completed. Molding of cord endings shown represents only one of hundreds of applications, but as they are familiar objects, it is easy to visualize the capacity range of "Eldorados."



Pat. Pending

Super "Eldorado" MINI-JECTOR, model 70VC105 (above) offers semi-automatic operation with push button controls in addition to all the advantages of the Standard "Eldorado", model 70VC95 (right) which is lever controlled.

"Eldorado" MINI-JECTORS are designed to solve a specific injection molding problem. They are the ideal answer to *fast, low-cost* production of small parts (1/3 oz. to 1-1/2 oz.) around inserts or loose cores. "Eldorado" MINI-JECTORS are daily molding a wide variety of precision parts in all thermoplastics.
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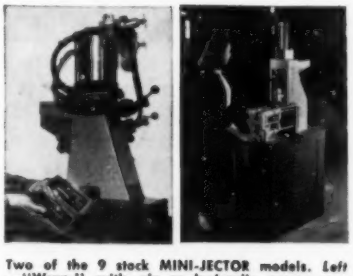

Two of the 9 stock MINI-JECTOR models. *Left*—"Wasp," with air or hydraulic power provides capacity of 1/3 oz. to 1 oz. Uses small "V" molds. *Right*—"Hornet" MINI-JECTOR has horizontal clamping and mold area of 6" x 5⅛" x 5". Molding capacity up to 1 oz.

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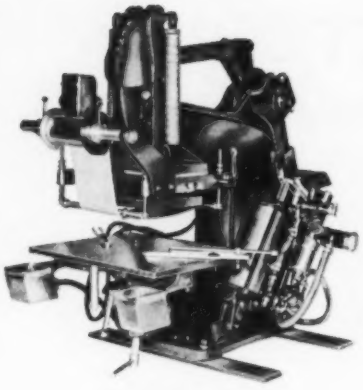

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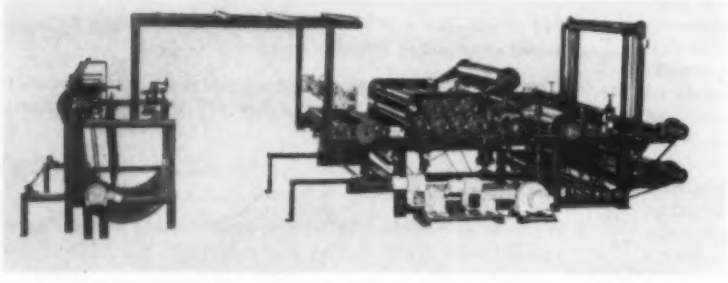

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panel substitutes for a five-piece assembly) and it becomes obvious why decorated plastics have grown three-fold in volume within the past five years.

Acknowledgments

In addition to the companies already mentioned, thanks for assistance in the preparation of this article go to the following: manufacturers of metallizing equipment—Consolidated Electrodynamics Corp., Rochester Div., Rochester, N. Y.; NRC Equipment Corp., Newton Highlands, Mass.; F. J. Stokes Corp., Philadelphia, Pa.; manufacturers of spray painting machines, masks, and other equipment—Conforming Matrix Corp., Toledo, Ohio; Finish Engineering Co., Inc., Erie, Pa.; Wm. M. Fiore, Inc., Brooklyn, N. Y.; Sepanski and Assoc., Grand Rapids, Mich.; Thierica Studio, Grand Rapids, Mich.; manufacturers and suppliers of hot stamping equipment, dies, marking machines, and roll leaf—Ackerman-Gould Co., New York, N. Y.; The Acromark Co., Elizabeth, N. J.; Admiral Coated Products, Inc., Brooklyn, N. Y., Apex Machine Co., College Point, N. Y.; General Roll Leaf Mfg. Co., Elmhurst, N. Y.; Kingsley Machines, Hollywood, Calif.; Markem Machine Co., Keene, N. H.; Olsenmark Corp., New York, N. Y.; Weber Hot Stamping Equipment Co., Chicago, Ill.; Peerless Roll Leaf Co., Inc., Union City, N. J.; suppliers of inks, lacquers, paints, and coatings—Interchemical Corp., Printing Ink Div., New York, N. Y.; Logo, Inc., Div. of Bee Chemical Co., Chicago, Ill.; Randolph Products Co., Carlstadt, N. J.; Red Spot Paint and Varnish Co., Evansville, Ind.; Wornow Process Paint Co., Los Angeles, Calif. Manufacturer of silk screening equipment—Silkscreen Div., Dependable Compressor & Machine Co., New York, N. Y.

Special thanks to: Arthur Skeels, Art Decorating Co., North Bergen, N. J.; Alfred M. Blumenfeld, Rohm & Haas Co.; and to the Society of Vacuum Coaters, Cleveland, Ohio.

For a complete list of suppliers, see the Directory Index, *Modern Plastics Encyclopedia Issue for 1959,* Sept., 1958.—END

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VINYL STABILIZER. 4-page brochure describes a vinyl stabilizer that minimizes performance variation due to resin or plasticizer or filler, eliminates storage problems due to exposure of a stabilizer or compound to oxidation or moisture. The Harshaw Chemical Co. **(D-911)**

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EPOXY RESINS. Technical bulletin describes clear and aluminum-filled epoxy resins for casting, laminating and adhesive uses where high heat resistance is required. Marblette Corp. **(D-914)**

POLYESTER RESINS. Series of technical data sheets give properties of this company's general and special purpose casting, molding and laminating polyester resins. Pittsburgh Plate Glass Co. **(D-915)**

FOAM PRODUCING RESINS. Technical bulletins describe a resin that will produce a flexible polyurethane foam for slab stock, and seating and cushioning applications; also a resin for producing "Freon" blown film with good sound and heat insulation properties. Pelron Corp. **(D-916)**

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REINFORCED TEFLON. Technical bulletins describe properties and applications of this company's reinforced Teflons as high temperature dielectric materials; also the use of reinforced Teflons in chemical processing, the aircraft and missile industries, etc. Rogers Corp. **(D-925)**

HEATING UNITS. 4-page illustrated brochure describes this company's lines of heating units for use in extrusion die heaters, plastic spray guns, etc. Brochure also describes units used in the processing of reinforced plastics, plastic molding, etc. Thermel, Inc. **(D-926)**

STEAM GENERATORS. Series of brochures describes line of steam generators featuring a system whereby steam is generated by resistance of the boiler water to the passage of electricity between solid metal electrodes, thereby completely eliminating low water hazards. Pantex Mfg. Corp. **(D-927)**

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GLASS FABRICS. 4-page specification guide gives properties, weave and weight information, etc., on this company's lines of glass cloth. Flightex Fabrics, Inc. **(D-932)**

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CHEMICALS FOR PLASTICS. 12-page brochure describes this company's lines of plasticizers, activated carbons, protective coatings, and coal chemicals. Presents uses. Industrial Chemicals Div., Pittsburgh Coke & Chemical Co. **(D-936)**

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SANDWICH PANELS. Illustrated 6-page brochure describes the available types and patterns of this company's translucent sandwich panels of polyester resin and glass fibre. Applications include spandrel panels, sliding door panels, partitions, drop ceilings, etc. Naugatuck Chemical Div., U.S. Rubber. **(D-939)**

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FLEXIBLE URETHANE FOAM RESINS. Technical bulletins describe polyester resins derived from polymerized fatty acids, and designed for use in the production of flexible urethane foams. Witco Chemical Co. **(D-942)**

PLASTIC IMPREGNATED MATERIALS. 20-page illustrated brochure describes features and uses of resin-impregnated papers for decorative laminates, phenolic-impregnated papers for industrial applications, phenolic-impregnated fabrics for high and low pressure molding, phenolic, polyester, epoxy and silicone-impregnated glass cloth, etc. Fabricon Products, A Div. of Eagle-Picher Co. **(D-943)**

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75% savings

(from pp. 100-103)

and weighing 13 oz., is molded of transparent Plexiglas by Master Molded Products Corp., Skokie, Ill., and decorated by Bert Mills. Design features include a large rectangular center opening for the slide-up door (fabricated of transparent Plexiglas sheet stock by Bert Mills) and 10 cored holes for mounting and assembly purposes. Though the cost of the acrylic bezel is approximately the same as that of the metal part, it offers more uniform color and maintains its attractive appearance longer because the decoration is protected by the transparent plastic surface. Also with the metal bezel, the thinness of the material resulted in undesirable "dimpling" where mounting screws were fastened. With the thicker, more rigid plastic bezel, this problem is eliminated.

Panels of metallized embossed Mylar are used as decorative trim on the fronts of the coffee vending cabinets and as protective coverings on the interior floors. Supplied with self-adhesive backing, they are easily mounted to the cabinet. The supplier of these pre-cut metallized plastic panels is the Fasson Div., Avery Paper Co., Painesville, Ohio. Extruded styrene is used in the cabinets in the form of a translucent white lens for a fluorescent tube light mounted across the front, near the top.

Vinyl uses

Non-toxic PVC film, 0.015 in. thick, is used by Hospital Liquids, Inc., Milledgeville, Ga., in fabricating the coffee supply hopper used in the fresh brew model machine. The seams are electronically sealed, with vinyl grommets built up at several points for mounting the hopper inside the cabinet. At the bottom, the hopper tapers from a square to a round shape, for mounting to a metal base by means of a stainless steel clamping band. It is light, sturdy, easily cleaned, and translucent, permitting observation of contents. Vinyl tubing extruded by Mayon Plastics, Hopkins, Minn., comprises the food hose through which hot beverages are dispensed into paper cups for customers' use.

Standard types of polyethylene pails, and one pail specially molded of high-density material by Rubbermaid, Inc., Wooster, Ohio, are used in the machines as waste containers for overflow liquid. Advantages of the pails include their light weight, which facilitates easier handling, and the fact that they will resist rust and corrosion.

Conclusion

The experience of Bert Mills points up the significant savings that can be effected by an analysis of cost and function of components in complicated mechanical units. In Bert Mills' case, not only were costs reduced, but quality was improved at the same time. While each part may be small in itself, taken together they represent a sizable percentage of the components of the over-all unit.— END

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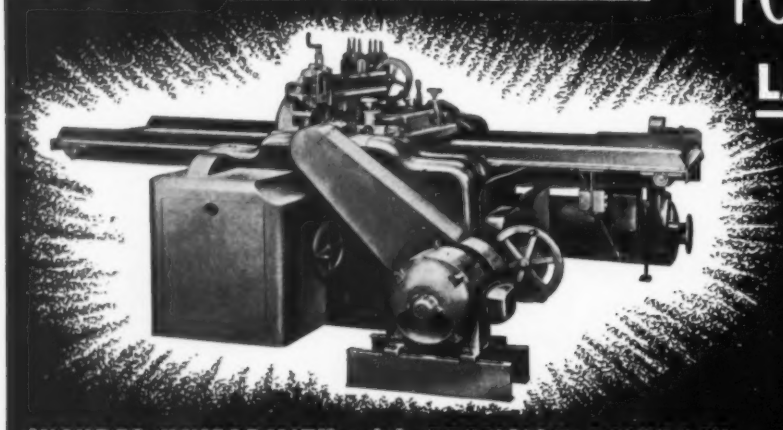

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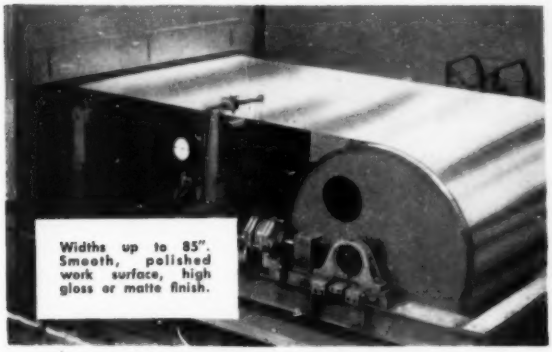

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Izod Impact Strength (ft. lb./inch of notch)		
@ 72°F	15 – 19	16.7+
@ -20°F	1.7	1.5
Heat Distortion Temp. (@ 264 psi)	145.4°F	158°F
Tear Strength (lbs./inch thickness)		
1. Graves — machine	630	882
2. Graves — transverse	680	943
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Chair frame

(*From pp.* 98-99)

Finished chairs weigh around 23 lb., as against approximately 60 lb. for upholstered chairs of conventional wooden frame construction. Unlike wood, the plastic frame offers practically no water absorption; as reported by Futorian, moisture content of a test frame, submerged for six months, ran only ½ of 1% of its total weight.

Since each molded plastic frame is identical, chairs lend themselves to a mass production basis. There is no variation in shape or dimensions from one frame to next, as occurs when wood is used. Also, waste is cut to a minimum, since only the required amount of molding material is placed in the mold. When wood is used for this purpose, much of the material is lost in cutting and shaping.

How frames are produced

Molds used by Futorian in producing the chair frames were made in Norway and are of relatively light cast aluminum construction. Molding pressures involved, using steam injection to fuse the styrene beads into a one-piece chair shell, are relatively low. Approximately 4 lb. of pre-expanded polystyrene beads are introduced into the hinged three-piece mold, which has been lined with burlap. During the molding cycle of approximately 8 min., the liner fuses with the expanded plastic material, reinforcing the surface of the chair shell. Upon removal from the mold, a wooden base which provides attachment for the chair legs and facilitates upholstering, is cemented to the bottom of the frame.

Upholstering the contoured plastic frames is relatively simple. Since the foam frame can be molded with varying thicknesses, the amount of padding required to achieve desired comfort or contours is greatly reduced. In addition, laborious webbing of back and seat, necessary in wooden frames to span the empty spaces between the wooden members, is eliminated. Fastening of the cover material is accomplished by tacking it to the wooden base.—END

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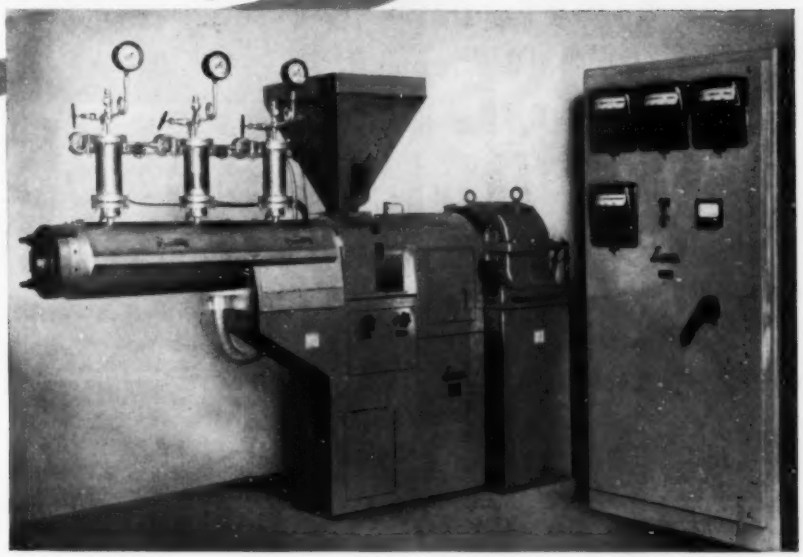

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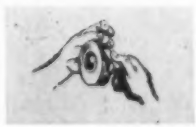

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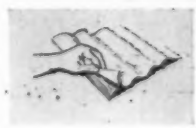

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Urethanes

(*From pp.* 109-113)

marketing patterns for this material. Their understanding is, in some respects, as important as a knowledge of the material itself for the full utilization of these foams.

The main division is between slabstock (for applications where the finished foam is used), and the production of foam as a captive operation as part of an assembly line.

The cushioning market is the main target of slabstock manufacturers, who require this volume outlet for the profitable use of their continuous foaming operations. Most of these companies—mainly traditional suppliers to the furniture industry—limit themselves to producing polyether foam and shipping the material as it comes off the production line, cut into the largest blocks which can be handled. Distributors, generally firms who are also distributors of latex foam, cut these slabs into sheets and fabricate the material to their customers' specifications. Since urethane does more than compete merely for some latex markets, some distributors, like General Foam Corp., New York, N. Y., for example, have built large plants, developed fabricating techniques, and expanded sales programs to cover industrial markets, in addition to the furniture trade. In general, slabstock manufacturers rely on distributors to supply regional markets and service specific industries, and only such major customers as the automotive industry are supplied directly by the foam producers. At present there is no large-scale production of rigid foam slabstock.

When it comes to making foam as a captive operation, the production methods are as diversified as the applications themselves. However, making urethane foam is a little like baking a cake, and there are two main methods of preparing the product. One is to buy the separate ingredients—isocyanates, polyols, catalysts, emulsifiers, etc.—from the basic chemical companies, and carefully mix them in pre-determined proportions to achieve the desired

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product. The other method is to let somebody else do the formulating, and merely add the water to the ready mix. The latter procedure is known as the prepolymer method in the urethane foam industry.

The prepolymer manufacturers, therefore, are a very important link between the raw material suppliers and the foam manufacturers, and some of them sell a complete package that includes suitable mixing and production machinery. Most of the prepolymer manufacturers have a large collection of "recipes" built up to serve specific needs of their customers in respect of density, pore structure, and physical properties of the foam. This cumulative experience enables them to reduce the margin of error in finding the most suitable formulations for a specific application. Since prepolymers cost only about 15% more than the raw materials, these companies are likely to grow in importance, especially as more applications are developed where foaming is only a part of a production set-up and where the end user does not wish to go to the expense of maintaining his own experimental and research organization. In this fast-moving field, adequate research facilities, such as those maintained by raw material suppliers and prepolymer manufacturers, are absolutely essential in order to remain competitive.

Typical of the service a prepolymer manufacturer can provide, is the work done by Thiokol in evaluating formulations suitable for curtain wall panels. The company found, for example, that castor oil has excellent adhesion, and a faster cure cycle at room temperature. On the other hand, where strength and good thermal insulation are required, certain polyesters have the advantage. But, for all-round performance, polyethers may serve best for most applications. Consequently, Thiokol can supply prepolymers to solve problems of adhesion, insulation, room temperature curing, buoyancy, etc.

Isocyanate Products, Inc., Wilmington, Del.; Nopco Chemical Co., N. Arlington, N. J.; Dayton Rubber Co., Dayton, Ohio, and its subsidiary, American Latex Corp., Hawthorne, Calif.; Freeman Chemical Corp., Port Washington, Wis.; Witco Chemical Co., New York, N. Y.; and Pelron Corp., Lyons, Ill., are also suppliers of prepolymers.

The future

Whether consumption of urethane foams in 1963 will reach the maximum estimate of nearly 300 million lb., or whether it will be closer to the 130 million lb. of flexible and 65 million lb. of rigid, which are more widely quoted, depends to some extent on continued progress in chemistry, more versatile machinery and, largely, on imaginative use of the material. But it seems certain that urethane foam—like every good product—will continue to find a host of uses undreamed of in the early stages of its development.

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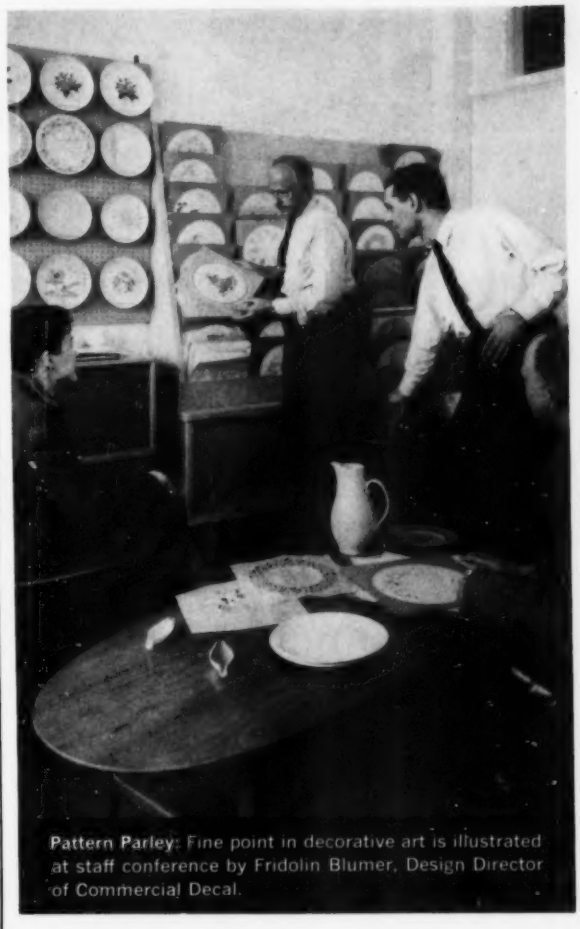

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(From pp. 137-148)

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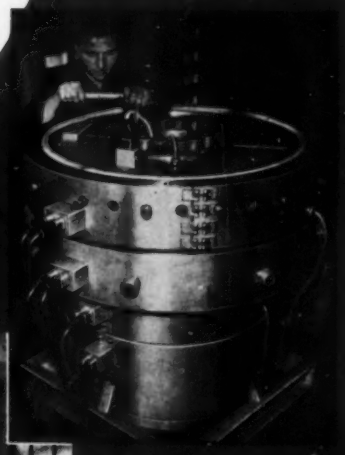

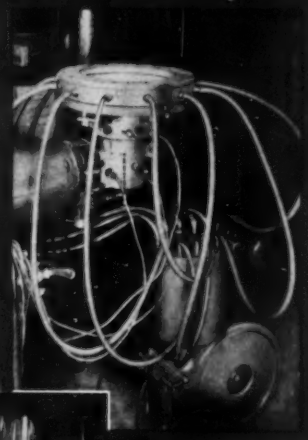

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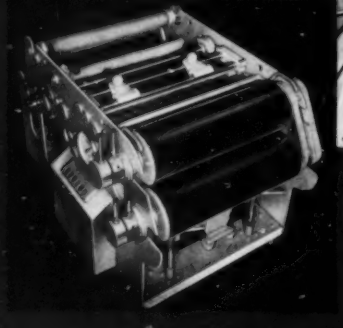

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Mixed polyamides

(*From pp. 150-156*)

shown by other compositions, such as nylon 66/pip-10, 610/pip-10, and 66/610/pip-6. Figs. 9 through 12 show that, in these materials, the maximum heat stability is exhibited when the components are present in nearly equal proportions. The dashed lines in Figs. 9, 11, and 12 indicate that specimens of these compositions when exposed for two days at 140° C. were too weak and brittle to test for tensile strength.

This dependence of heat stability on composition can be explained by consideration of the two principal causes of changes in the physical properties of polyamides upon exposure to elevated temperatures. First chemical changes in the molecule take place due to oxidation and chain cleavage. This action seems to occur most rapidly in the amorphous areas of the polymer. Second, crystallization, induced by the elevated temperature, causes embrittlement and deterioration of physical properties. Therefore, it would be expected that a material having a rapid rate of crystallization would become more nearly completely crystallized during processing and be inherently more heat-resistant. A material having a relatively low melting point would be expected to crystallize more completely since its rate of cooling during extrusion, for example, would be less than a material having a higher processing temperature. A composition having nearly equal proportions of several ingredients would possess the maximum degree of randomness and, therefore, have the least amount of potential crystallinity. If one ingredient were piperazine, with no hydrogens available for bonding, even less potential crystallinity would be expected. Therefore, our observation that terpolymers containing piperazine and with proportions of ingredients nearly equal are the most heat stable is theoretically sound.

Naturally, a polymer having relatively little crystallinity would be vulnerable to prolonged attack by high temperatures due to chemical changes occurring in the amorphous areas. However, protection of these portions of the polymer may be provided by the use of chemical stabilizers such as antioxidants.

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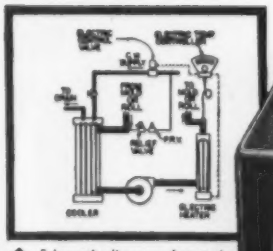

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THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 39)*

April 1959

What's happening in the plasticizer market?

When plasticizer manufacturers reduced the list price of dioctyl phthalate (DOP) from 28 to 25¢/lb. it was an attempt to stabilize a situation that has been deteriorating for several years. Very little was sold at the list price of 28¢ as producers maneuvered to meet a plethora of "deals" that existed in the industry. The new price was announced simultaneously with Monsanto's statement that phthalic anhydride had been reduced from 21 to 16½¢ in tank car prices. When phthalic drops in price DOP can be produced at less cost and Monsanto wasted no time announcing that the DOP price reduction would follow the phthalic decline.

The usual pattern has been for the DOP price to decline 1/10 of a cent for each penny decline in phthalic, but Monsanto shot off both barrels of its shotgun and winged two pigeons at once. They accounted for the price decline in phthalic with one barrel and for the pigeons that had been dealing out DOP at cut prices with the other. It is possible that this move may also help to drive out the off-color DOP material that has been on the market.

It was a foregone conclusion that other producers would reduce the price of phthalic when Amoco announced that its phthalic would be priced at 17¢ when available. The Amoco announcement was made last summer when the company stated it would go on stream in the near future with a new plant to produce phthalic, isophthalic, and terephthalic by a new oxidizing process. That plant is now about ready for production with a total capacity of from 50 to 60 million lb. a year but there is no certainty on how much of it will be phthalic. The quantity of each of the three depends on components of the crude stream fed into the separator, but talk in the trade is that generally speaking the plant would produce around 10 million lb. of phthalic. This is a tiny amount compared with the 350 million lb. of phthalic used annually but other producers apparently became nervous and lowered the price of their material from its former price of 21¢ even before the Amoco plant had come on stream.

Regardless of the reason, DOP and DIOP plasticizers, which are by far the most widely used of all plasticizers for vinyl chloride compounding, are now 25¢/lb., a new all-time low. They account for at least 120 million lb. of the 310 million lb. of plasticizers used with vinyl chloride. The question now is what effect will this low price have on the use of other plasticizers since DOP and DIOP are generally conceded to have as good (or better) all-around properties as others?

It could be that formulators will use a greater percentage of DOP in their compounds, but plasticizer producers seem confident that other plasticizers which have always been used in smaller proportions in a vinyl compound to impart particular properties will continue as before but possibly in smaller portions.

For example, it is desirable for vinyl drapes to be fire resistant, so they need a portion of phosphate plasticizer. Upholstery, especially automotive type, must have low-temperature flexibility and will need adipates and azelates, at 40¢, in a portion of the plasticizer content. Baby pants must be resistant to soapy water and thus create a market for diisodecyl phthalate at 26 cents. Heavy filled sheeting of the type used for pocketbooks may continue to use butyl benzyl which is now the same price as DOP but was previously lower cost. Polymeric plasticizers which range up as high as 60¢ will continue to be necessary in gasketing and other materials to help prevent migration.

In the wire coating field there will be a need for such plasticizers as DIDP and the pentaerythritol derived plasticizers that will withstand high temperature and have good electrical properties. In floor tile there is always a butyl benzyl and butyl octyl phthalate will be required because of their imporved salvating power.

Normal octyl normal decyl plasticizer, a real-high grade general purpose material that always sold a few cents over DOP is now 28½¢, but because of its good flexibility properties at low temperature will probably always be in demand for such applications as upholstery if the price gap doesn't widen.

Dicapryl at 24½ or 25¢ is in demand for plastisols because of its initial low viscosity but there isn't too much of it around.

Tricresyl phosphate, once in popular demand and especially good for fire resistance, is less used because of its 32½¢ price.

There are many other examples where higher priced plasticizers will continue to be used to impart special properties to a vinyl compound but that 25¢ price for DOP is certainly a tempting bait for any formulator who thinks he can use more of it and less of the specialty plasticizers to produce an adequate product.

A new epoxidized stabilizer-plasticizer

An epoxidized plasticizing stabilizer produced from pure soybean oil which, the producer asserts, is quite different from other epoxidized stabilizers, is now in commercial *(To page 210)*

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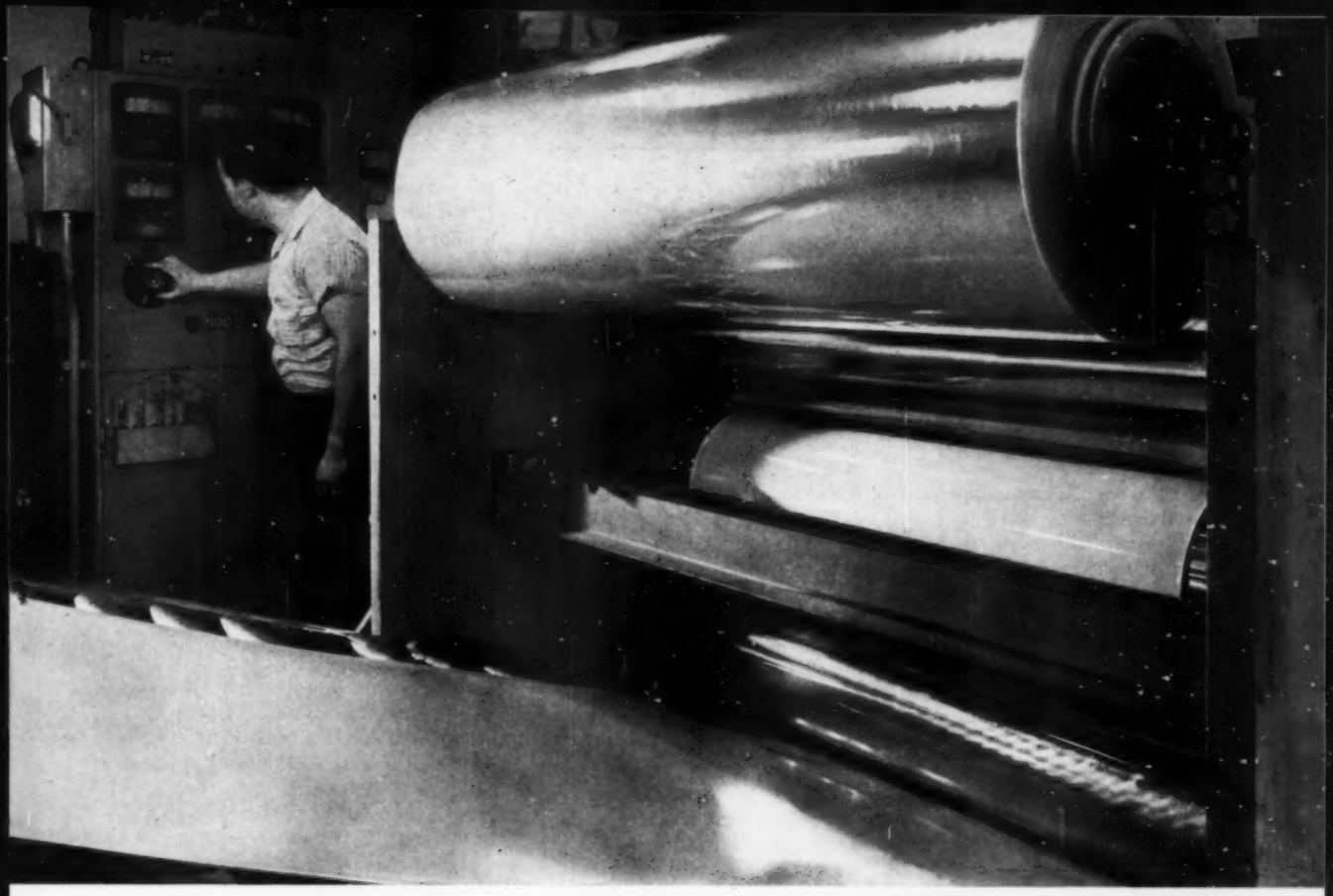

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THE PLASTISCOPE

(*From page 208*)

production by General Mills, Inc., Minneapolis, Minn. Two formulations are available, EpoxyGen 80 and EpoxyGen 90, the first of which is 80% epoxy and the other is 90 percent.

Epoxidized plasticizers have been around for several years. They were first introduced as plasticizers but their stabilizing properties soon became apparent. As stabilizers they were used in small proportions such as 5 or 10% of the plasticizer content in a vinyl chloride formulation to improve heat and light resistance as well as plasticizers in the plasticized product. Today they may be used in quantities as high as 25 to 50% of the plasticizer formulation and are particularly useful for film, shower curtains and automotive upholstery. However, they are *not* suggested for use at temperatures higher than encountered in the applications mentioned above nor in electrical applications.

The point of emphasis for EpoxyGen, according to General Mills, is that it gives "up to 10% higher epoxy content in the finished product than usual epoxidized oils; has up to 50% less impurities and up to 50% lower viscosity." General Mills claims that vinyl compounders will benefit from EpoxyGen's use because "it gives 25 to 40% greater heat stability; is more compatible; has less tendency to 'spew'; is more uniform."

The General Mills epoxies derived from soybean oil are of course an entirely different material than the epoxy type resin produced from bisphenol A and epichlorohydrin which are used for coatings, casting and structural uses and sell in the 50 to 60¢/lb. range. They are also different from the epoxy monoesters used as plasticizer-stabilizers to prevent low temperature brittleness. It is anticipated that they will be used with the epichlorohydrin type in corrosion resistant paint and potting compounds to reduce cost without impairing properties. Another possibility that may develop is their use with a foaming agent and Du Pont's PMDA to produce vinyl foam.

EpoxyGens do not eliminate the need for metal salt stabilizers but are synergistic with many of them particularly the barium and cadmium stabilizers. The combination gives enhanced light stability although requiring less metal stabilizer.

The price of EpoxyGen 80 is 33¼¢/lb. in quantity lots—EpoxyGen 90 is 35¼ cents.

A new secondary plasticizer

Continental Oil Co. has introduced a new and improved secondary plasticizer designated Conoco H-35. The company's other product in the field is H-300. The price is 11¢/lb. in tank or truck loads—13¢ in drum car loads. The new H-35 is claimed to be water white and have greater compatibility than other secondaries—assertedly it can be used in every vinyl formulation where color is of prime importance while most other secondaries are said to impart some color of their own to the finished product. The heat and light stability of H-35 is said to be almost equal to DOP, which is claimed to be unusual for secondaries. Both of these plasticizers are suggested for plastisols to help make them less viscous. H-35 can be used successfully to replace 30% of the total plasticizer content in many vinyl formulations, according to company literature.

Teflon for extrusion

Du Pont's new Teflon 100-X FEP fluorocarbon resin is now available in development quantities. Uses for FEP resin include wire coatings; chemical-resistant jacketing; tubing, including shrinkable tubing for harnesses; heat-sealable film for bonding TFE resin to itself or other substitutes; and moldings, such as valve linings, slip ring encapsulation and wave-guide insulators.

The development price is $19/lb. but this price will drop to about $12/lb. later this year when commercial quantities become available. It is anticipated that future prices for FEP resin will follow the general pattern of Teflon TFE-fluorocarbon resins, which dropped by more than 75% in the past 15 years—from $18/lb. in 1944 to the present price of $4.10.

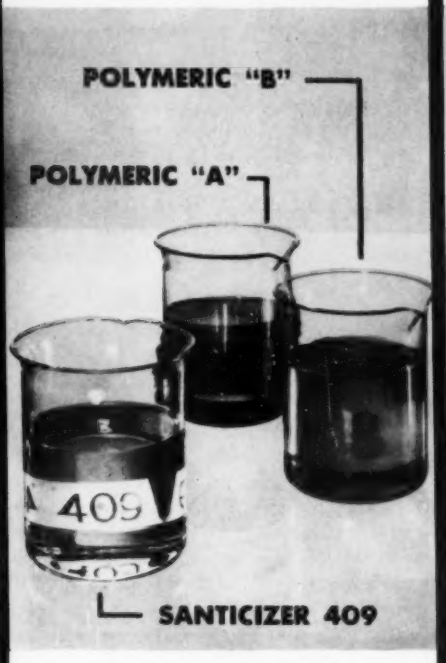
Vinyl-to-metal adhesives

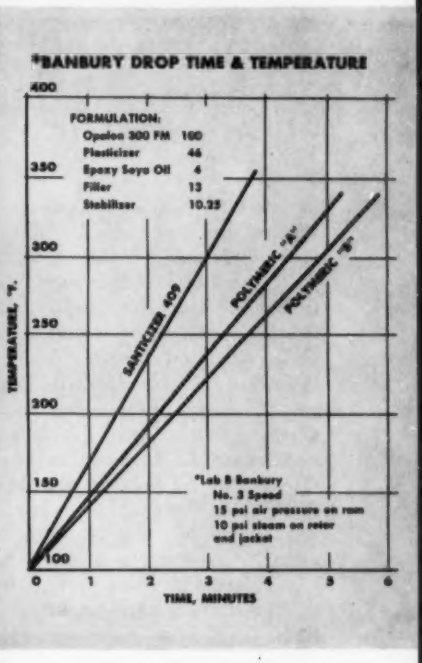
A new coating system for bonding vinyl sheet or plastisol to metal has been announced by B. F. Goodrich Industrial Products Co. The system involves a new synthetic cement—A-978-B and a specially formulated plastisol. The firm claims that this new cement will "stick" under tests where other vinyl-to-metal adhesives fail and that when sheet steel is bonded to vinyl with the new material it can be stretched 35% without weakening the bond or damaging the vinyl coating. The tests mentioned above include boiling in water for 30 min., exposure to 200° F. for seven days, and humid storage at 160° F. for 1000 hours. The adhesive- coating, which takes care of both priming and adhesion, was originally designed for spread-coated plastisol steel sheeting but is equally effective with vinyl sheet that is laminated to steel. It may be applied by brush, spray, float, or roll coater and allowed to air dry. Users may purchase the adhesive either by itself or with the BFG plastisol especially developed for this application in a completely packaged metal coating system.

The adhesive is produced in a new plant, which is BFG's first major expansion in Akron since 1950. The plant will produce everything in adhesives from stationery cement for office use to tough adhesives used in airplanes and brake linings. Clyde O. DeLong, president, expects the adhesives industry to double in size in the next five years.

Adhesive for laminates. The Stanley Chemical Co., East Berlin, Conn., has announced a new special thermosetting adhesive, Stanley No. 69X-1487 for bonding vinyl-metal laminates. The new adhesive is applied with heat and pressure and is said to withstand drawing pressures exceeding the fracture point of the metal itself. Vinyl (*To page 212*)

Monsanto's new SANTICIZER 409 gives "high-priced" properties at the lowest cost of any polymeric plasticizer!





"Permanent" Benefits

To end summer "fog-up" on car windows from plasticizer volatilization (the most urgent problem confronting vinyl upholstery and coating producers), SANTICIZER 409 offers the best, lowest-cost answer. Simulated service tests prove it stays in the product longer than many higher-priced polymerics. SANTICIZER 409 is less volatile, does not migrate or exude—even in high humidity—as do many other polymeric plasticizers. Also, it is more resistant to extraction by soapy water, alkalies, solvents and oils, and has superior electrical properties.

Lighter Color, Lower Odor

Compared to two commercial polymeric plasticizers (above), SANTICIZER 409 has a lighter, clearer color and far less odor. Its good heat and light stability help finished products retain their true colors, plasticity, attractive appearance and other important physical properties. SANTICIZER 409 contains no flocculent matter or sediment to cause spotting in thin films, transparent sheeting and similar products. Its high purity contributes to excellent electrical properties in vinyl insulating compounds.

Fastest Fusion

SANTICIZER 409 speeds the fusion of vinyl compounds faster than many other polymerics. Its high solvating power, low viscosity and plasticizing efficiency may cut your processing time, or improve your compound's physical properties within your processing temperature limitations. SANTICIZER 409 mixes readily with a variety of monomeric plasticizers and is highly compatible with cellulose acetate butyrate, nitrocellulose, polyvinylidene chloride and PVC.

- If you now use or can use a polymeric-type plasticizer, you can't afford *not* to evaluate new SANTICIZER 409. Use-rated and job-proved, it can give you exclusive advantages *at lowest cost* in products such as: electrical-grade plastisols; coatings for moisture and corrosive-fume protection of dishwashers, ventilator ducts and similar products; long-service profile extrusions such as refrigerator gasketing; coated fabrics, film and sheeting, adhesive-backed tapes and free films.

Write on your company letterhead for a sample of SANTICIZER 409 and compounding help from Monsanto's Plasticizer Council.

SANTICIZER: Monsanto T.M., Reg. U.S. Pat. Off.

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THE PLASTISCOPE

(*From page 210*)

cladding on steel, magnesium, and aluminum is used for TV and radio cabinets, automobile fixtures, trim, luggage, card tables, chairs, and wall panels.

Makes epoxy rod

Several types of epoxy rods for use as precision insulators, brake spools, slip ring assemblies, etc., are being produced by Brilhart Plastics Corp., Mineola, L. I., N. Y. Designated the 500-38 Series, the rods are available in the following categories: Type A—clear amber, unfilled; Type A/C—unfilled, colored for identification of assembly parts; Type E—filled, uncolored; and Type E/C—filled and colored.

Typical fillers available in commercial stock are mica, slate, silica, aluminum oxide, negative coefficient of expansion ceramic fillers, and, on request, also calcium carbonate or talcs.

The rods are cast, molded, or extruded, and are available with a standard OD from ¼ to 8 in. in lengths of approximately 3 feet.

Pilot plant production of an epoxy rod with a conductive filler has also been announced by the company.

Vinyl coated fabrics drop

Shipments of vinyl coated fabrics in 1958 amounted to 76,925,300 linear yards—a decline of approximately 17% from the peak year 1957, and the lowest volume since 1954.

These figures, released jointly by the Vinyl Fabrics Institute and the Rubber Manufacturers Assn., represent information supplied by 26 firms participating in the statistical program and indicate the industry trend.

Shipments of the three main categories during the last five years are shown in table below.

Intermediates for plastics

Outstanding thermal stability and improved electrical properties are said to be provided by pyromellitic acid (PMA), and pyromellitic dianhydride (PMDA)—two new chemical intermediates which will be produced by Du Pont.

PMDA is expected to be useful as a hardening agent for epoxy resins, a component of vinyl plastisols, intermediate for the preparation of vinyl plasticizers, and as a modifier in polyester molding resins or alkyd resins. PMA can be used interchangeably with PMDA in certain of these applications.

A small commercial unit for the manufacture of these intermediates is expected to go into production at the Explosives Dept.'s Repauno Works, Gibbstown, N. J., at the end of 1958.

General Aniline & Film Corp. has started semi-commercial manufacture of 2-butene-1,4 diol, a chemical intermediate used in the production of polyesters. Like other diols, this chemical can also be used as a polyol in the manufacture of urethane foams.

Trycite plant on stream

The first full-scale production plant for Trycite, The Dow Chemical Co.'s low-cost, thin-gage polystyrene film, has been placed on stream in Cleveland, Ohio.

Trycite, introduced last May at the National Packaging Exposition, is a flexible film for packaging application.

Dow has been supplying Trycite on an allocated basis from pilot plant facilities in Midland, Mich., until the Cleveland plant was in production.

Because of its clarity and dimensional stability, Trycite has gained acceptance from manufacturers of window envelopes and cartons, and small bags and pouches. In addition, Dow says, it is being used as an overwrap for gift wrappings, games and puzzles, and as a high-gloss laminate for paper and high impact plastic sheet.

Dow officials expect to sell the entire Cleveland output by the third quarter of 1959.

Laminate for printed circuits

A new flame-resistant material for printed circuit applications is available from National Vulcanized Fibre Co. Designated Phenolite Grade XXXP-475, this material is paper-based, laminated with a modified phenolic resin, and is said to offer excellent electrical properties, very high insulation resistance, and low moisture absorption.

According to the company, the new laminate affords the same flame-resistance as paper-based epoxy grades, at cost reductions of about 40 percent. It yields excellent punching results with a minimum of heating in the range of 130 to 150° F., the company claims.

Grade XXXP-475 is offered as a standard laminated plastic, and in copper-clad form for printed circuit bases, in thicknesses from 1/32 to ¼-in., and sheet sizes 39 by 47 in., and 39 in. square.

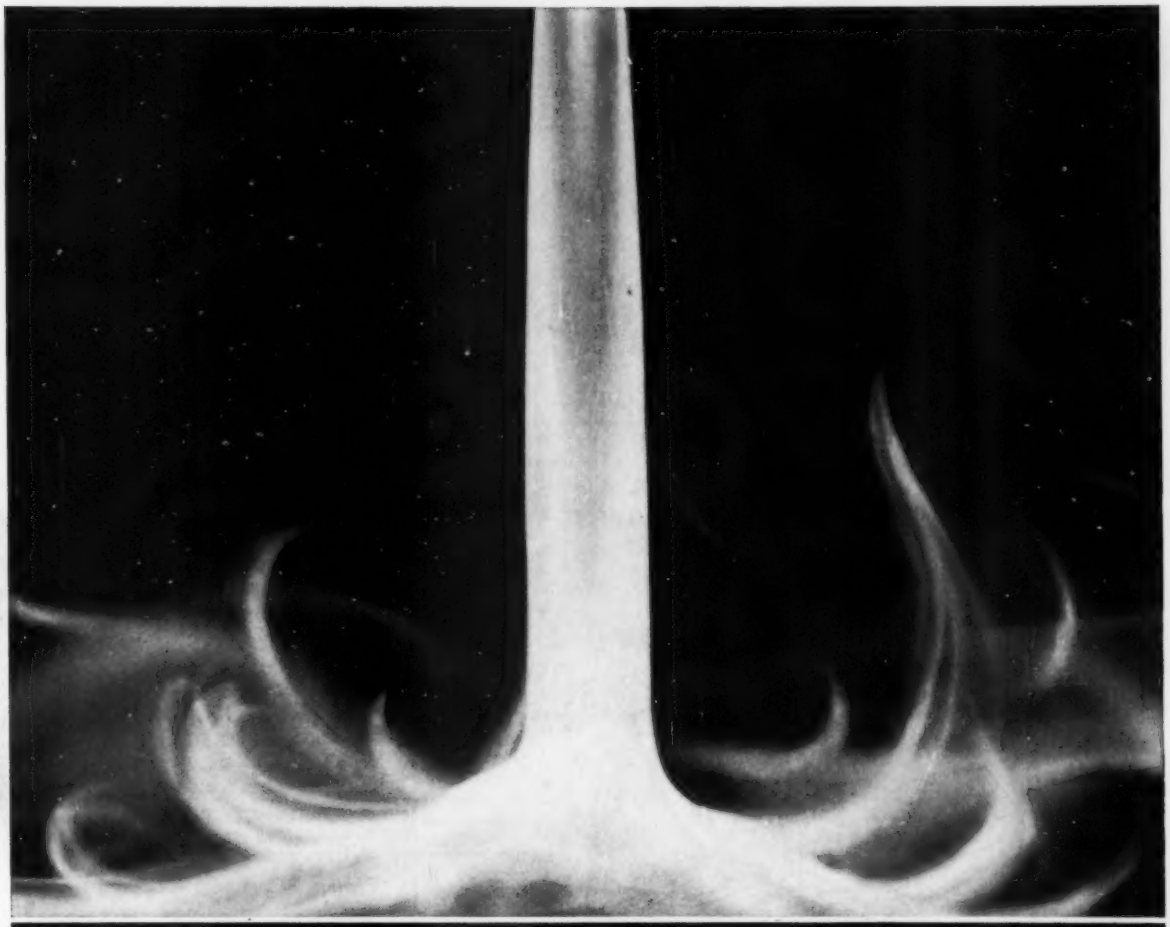
New applications group

Formation of a new applications group, to be known as the Plastics and Elastomers Div. at the company's research center has been announced by Hercules Powder Co.

The new division, to be headed by John R. Lewis, will be responsible for product development work on thermo- *(To page 214)*

Annual total shipments of vinyl-coated fabrics (in thousands)

	Vinyl-coated fabrics	*Unsupported vinyl sheeting*	*Pyroxylin-coated fabrics*
	linear yards	*square yards*	*linear yards*
1954	59,428	47,596	25,867
1955	91,669	51,671	27,723
1956	83,042	48,174	28,169
1957	92,136	47,177	27,101
1958	76,925	41,668	22,093



Flame retard at LOW COST with Diamond Chlorowax 70®

With either high or low density polyethylene, you can control flame resistance *to meet your needs* by adjusting content of Chlorowax 70 and antimony trioxide. Flame-retardent polypropylene can also be tailored in much the same manner.

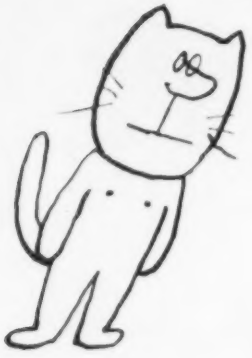
Physical properties remain relatively unaffected, as shown for polyester and polyethylene compounds. If you formulate for boat hulls, electrical equipment or other applications where fire safety is important, write for details. Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

POLYESTER SYSTEM		Control Compound	Chlorowax Compound
Polyester Resin	(parts by weight)	100.0	100.0
Chlorowax 70	(parts by weight)	—	12.5
Antimony Trioxide	(parts by weight)	—	12.5
Luperco ATC	(parts by weight)	2.0	2.0
3 oz. Glass Mat	(parts by weight)	60.0	60.0
Flexural strength psi (dry)		26,400	27,500
Flexural strength psi (wet)		24,000	25,000
Tensile strength psi (dry)		15,000	15,700
Tensile strength psi (wet)		14,000	14,300
Flame-out (seconds)		Burns	1
POLYETHYLENE SYSTEM*			
Polyethylene Resin	(parts by weight)	100.0	85.0 — 63.0
Chlorowax 70	(parts by weight)	—	7.5 — 18.5
Antimony Trioxide	(parts by weight)	—	7.5 — 18.5
Antioxidant	(parts by weight)	.5	.5
Tensile strength (psi)		1,800	1,650—1,500
% elongation		600	590— 200
Flammability		Burns	Self-extinguishing

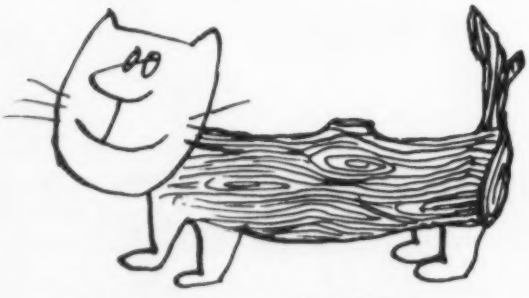
*Patented compound. License available.

Diamond Chemicals

If you have never seen
a cat a lyst*



write for our cat alog*



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BUFFALO 5, NEW YORK

THE PLASTISCOPE

(From page 212)

plastic polymers, thermo-setting resins, filled and reinforced plastics, and rubber compounding and evaluation.

Establishment of this division is a result of expanded product development work. Hercules is now producing high-density polyethylene, polypropylene, and Penton, a chlorinated polyether. In addition, Hercules recently acquired the Young Development Laboratories, a manufacturer of filament wound fibrous glass-reinforced plastics.

Polystyrene film price drop

Reductions of approximately 3¢/lb. for biaxially oriented polystyrene film and sheet materials were announced by Plax Corp., Hartford, Conn.

The lower prices for the company's Polyflex materials apply to all gages from 0.001 to 0.020 in. for the laminating, vacuum forming, pressure forming and general purpose grades.

Nylon venture cancelled

Spencer Chemical Co. and Industrial Rayon Corp. have decided not to proceed with plans to construct jointly a $10 million plant at Ashland, Ky., to produce caprolactam, a basic raw material used in the manufacture of nylon. The companies stated that the planned entry of Du Pont into the caprolactam field led to this change in plans.

The joint venture, under the name of Ohio River Chemical Co., was first announced in July, 1958. Spencer indicated it would retain the plant site, but stated it had no immediate plans for its use.

PE for baking industry

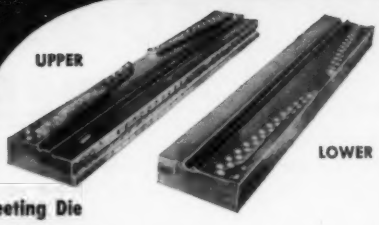
A complete packaging service for polyethylene bread-wrapping is offered by Nashua Corp., Nashua, N. H.

The company supplies PE film, waxed bands, end labels, and an attachment for running PE film on bread-wrapping machines at normal production speeds.

A double seal of the bread package is obtained by heat-sealing the folded ends of the PE wrapper and affix- *(To page 216)*

Preferred and used

by the largest producers of plastic sheets



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Now 2 types
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Featuring adjustable Die lip for production of sheets from .020" and heavier, plus adjustable Restrictor Bar assuring uniform material distribution, these highly polished, chrome-plated Dies produce a quantity and quality of product to meet the most exacting requirements. Drilled and tapped for pressure gauges and Thermo Couplings, the Die is equipped with bleed-off holes at either end . . . wired into heating zones with heat supplied by cartridge-type heaters . . . complete and ready to attach to your control panel.

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PHILADELPHIA, PA.	Berton Plastics, Inc., 1405 Locust St.
ATLANTA, GA.	Glascoat, 1849 Cheshire Bridge Rd., N. E.
MIAMI, FLA.	Glascoat, 150 N. W. 176 St.
CINCINNATI, OHIO	Cadillac Plastic Co., 1200 Walnut St.
CLEVELAND, OHIO	Cadillac Plastic Co., 3333 Detroit Ave.
CHICAGO, ILL.	Cadillac Plastic Co., 727 West Lake St.
DETROIT, MICH.	Cadillac Plastic Co., 15111 Second Ave.
MILWAUKEE, WISC.	Cadillac Plastic Co., 517 North Broadway
ST. LOUIS, MO.	Cadillac Plastic Co., 2111 Olive St.
KANSAS CITY, MO.	Cadillac Plastic Co., 1517 Grand Ave.

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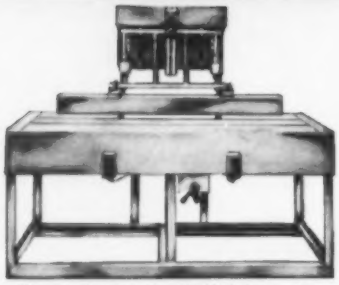

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Why let "skimpy power" rob you of the quality production you require? For more facts on electronic heat sealing, write or phone today for Sealomatic's helpful brochure, and arrange to see a representative. Remember, there are standard model Sealomatics from ½KW to 30 KW, including automatic turntable units, as well as models for applique work, lamp shade work, and automatic roll feeding. Thermal units are available for blister packaging and fast drying of adhesives.

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WEST COAST BRANCH

THE PLASTISCOPE

(From page 214)

ing PE and labels. According to the company, the complete PE package gives bread a longer shelf life and more consumer appeal.

DAP molding compounds

Five grades of diallyl phthalate molding compounds are now being produced by Rogers Corp., Rogers, Conn.

Two grades (SD1-5 and MDG) have been approved under government specifications Mil-M-18794 and Mil-P-14E, including a range of colors. Three other grades, SDG, SD1-30 and GD1-30, are currently undergoing government qualification tests.

The diallyl phthalate compounds represent the latest addition to the company's line of insulating materials, which cover the complete range of Class A through Class H.

Fire retardant foam

United Cork Companies, Kearny, N. J., announces the development of a fire retardant polystyrene foam called "Uni-Crest". Weight range is from 1 to 20 lb./cu. ft. Suitable for bracing, blocking and surface protection of packages, Uni-Crest has a smooth, tough surface that can be painted and flocked; multicolored polystyrene beads can be molded together in one process to produce a finished product with a mottled effect throughout. When molded with a polyethylene shell, it makes a lightweight, practically indestructible toy.

Grease resistant PE coating

Development of a grease resistant coating with performance characteristics claimed to be equal in most cases to laminations has been announced by Allied Chemical's Semet-Solvay Petrochemical Div.

The coating, a 100% PE blend made up of A-C polyethylene and other polyethylenes, can be applied with a conventional reverse roll coater.

According to Allied, existing standard equipment can be used in the coating process. Possible applications include *(To page 218)*

HELPFUL BOOKLETS FREE!

FOAMED POLYSTYRENE. Illustrated 38-page booklet describes properties, characteristics, molding and fabricating methods, and product applications for expandable polystyrene. Koppers Co., Inc. **(D-906)**

FLAME-RETARDING PLASTICIZER. 12-page technical bulletin describes tricresyl phosphate, a monomeric plasticizer for imparting flame retardance to polyvinyl chloride, nitrocellulose, and other synthetic resins. Organic Chemicals Div., Monsanto Chemical Company. **(D-912)**

SYNTHESIZING SYSTEMS. 16-page illustrated brochure describes pilot plants, kettles, and auxiliary equipment for use in synthesizing and polymerizing, heating and cooling of synthetic resins, plastics, adhesives, varnishes, etc. The Patterson Foundry & Machine Co. **(D-930)**

BUTADIENE. 44-page illustrated brochure discusses the potentialities, physical and chemical properties, derivatives, specifications, analytical procedures and physiological properties of butadiene. Petro-Tex Chemical Corp. **(D-937)**

PLASTIC IMPREGNATED MATERIALS. 20-page illustrated brochure describes features and uses of resin-impregnated papers for decorative laminates, phenolic-impregnated papers for industrial applications, phenolic-impregnated fabrics for high and low pressure molding, phenolic, polyester, epoxy and silicone-impregnated glass cloth, etc. Fabricon Products, A Div. of Eagle-Picher Co. **(D-943)**

Any of the booklets described here, plus many others—44 in all—are available for the asking, without charge or obligation.

Just turn to the Manufacturers' Literature page in this issue (pages 193, 194), circle the numbers on the reply postcard corresponding to the booklets you want, fill in the address and mail.

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Model PL 6/10

Europe's largest injection molding machine (350 oz.) . . . with preplasticizer and possibility for a wider daylight

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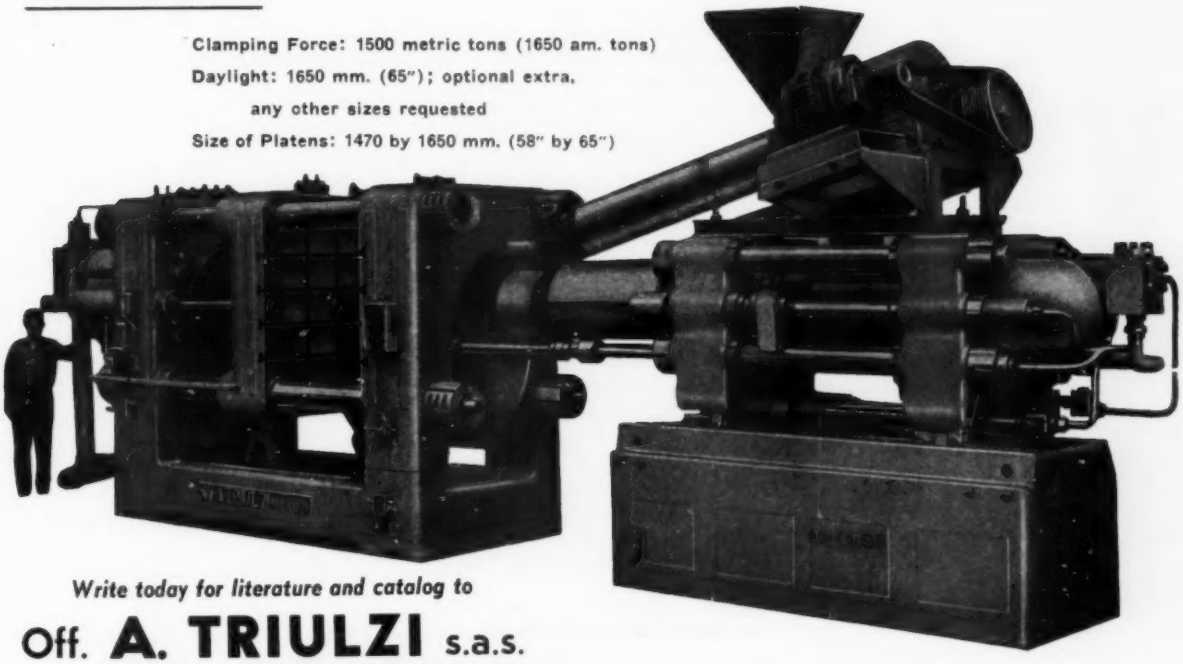
Minimum Ø: 550 mm. (22")
Maximum Height: 650 mm. (26")

TRIULZI Model PL 6/10

Clamping Force: 1500 metric tons (1650 am. tons)
Daylight: 1650 mm. (65"); optional extra, any other sizes requested
Size of Platens: 1470 by 1650 mm. (58" by 65")



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THE PLASTISCOPE

(From page 216)

board and paper bakery goods, fresh and prepared meats or wherever grease is a problem.

In tests by Allied, a variety of blends was run on a reverse roll coater at 280 to 350° F. using both paper and board stock with minimum penetration. An all-surface coating of about one mil (13.7 lb. of resin per 3000 sq. ft.) was found to be the most satisfactory. Moisture vapor transmission tests showed greater resistance in some cases than laminated film now in extensive use, the company reports.

Scholarships available

Students majoring in plastics engineering or chemistry at Lowell Technological Institute, Lowell, Mass., can apply for the following scholarships for the coming academic year: Society of Plastics Engineers, $200 for one year to a junior in plastics engineering; Interchemical Corp., $250 per year to each of two juniors and two seniors in chemistry, physics, or allied sciences; and U. S. Rubber Co., $500 to a senior without stipulation as to course, incurring an obligation to repay 25% of the amount after graduation.

Application should be made to the Director of Admissions, and freshmen applicants for admission, as well as for scholarships, must complete the Scholastic Aptitude Test of the College Entrance Examination Board.

Contest for children

To stimulate customer interest in its Poly-Pro brand polypropylene, which will become commercially available in 1960, Spencer Chemical Co. is conducting a coloring contest for children. Prizes will be awarded. Judges in the contest are: Charles A. Breskin, chairman of the board, MODERN PLASTICS; William Cruse, executive vice-president, The Society of the Plastics Industry, Inc.; and Stan Eckman, artist who created the "Poly-Pro" symbol.

New source for polystyrene

Virgin high impact polystyrene, natural and in colors, and crystal polystyrene are *(To page 220)*

BOOST EXTRUDER OUTPUT WITH

MICROLIMIT CONTROL

continuous, noncontact gauging and automatic control of dimension *of rod, tubing, shapes and insulated wire*

Instantaneous quality control—of your product while still in a plastic state – right at the die – at any speed! Only MICROLIMIT CONTROL can offer all this . . . and many other exclusive features. Let us show you how MICROLIMIT CONTROL can help you produce to closer tolerances, save compounds and labor, and speed production.

Contact your local Daystrom-Weston representative . . . or write to Industrial Gauges, West Englewood, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 10, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

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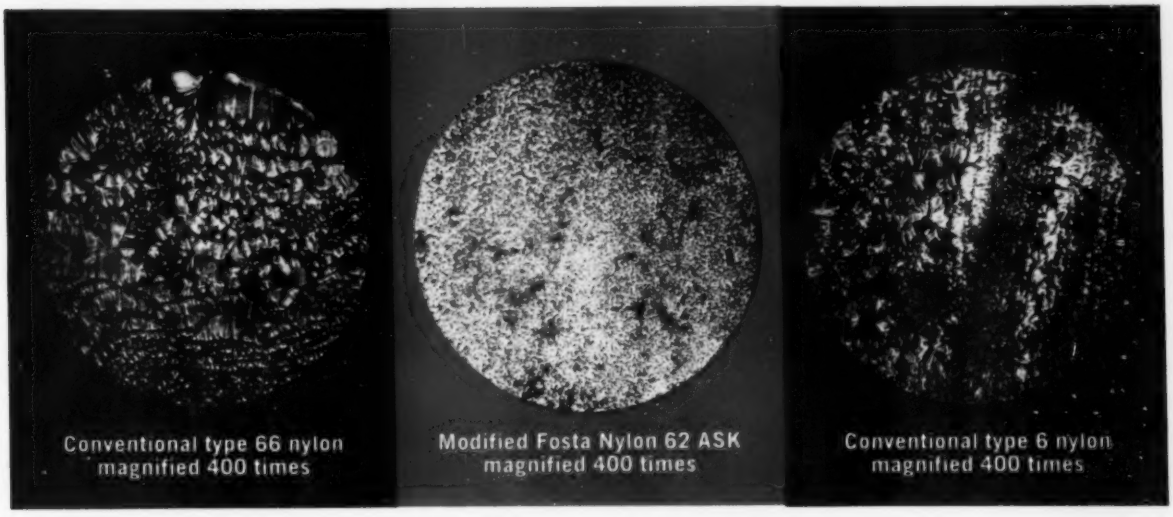
AUTOMATIC CONTROL AT THE POINT OF PRODUCTION

chemicals
FOSTER GRANT
plastics

New Modified Nylon

FOSTA NYLON 62 A.S.K.



Conventional type 66 nylon magnified 400 times

Modified Fosta Nylon 62 ASK magnified 400 times

Conventional type 6 nylon magnified 400 times

ONLY
FOSTER GRANT
COMBINES:

- ★ Its own monomer plant
- ★ Its own polymerization plant
- ★ Its own nylon plant
- ★ Precise color matching
- ★ Precise quality control
- ★ 40 years of molding experience
- ★ Machine design
- ★ Tool and die services
- ★ Marketing aid
- ★ Technical assistance

TO ASSURE SUPERIOR
QUALITY OF **YOUR** PRODUCTS

Fosta Nylon 62 ASK is a unique *modified* nylon that offers you faster and more efficient molding. No other nylon on the market today gives you the uniform crystallinity of Fosta Nylon 62 ASK. Here is a nylon that is especially suited to molded items having thick-thin sections.

And, because it is a *modified nylon,* 62 ASK also provides a greater degree of heat distortion, tensile and impact strength, and increased surface hardness.

To give you one example of the superiority of Fosta Nylon 62 ASK, an eight cavity comb mold ran at a 40 second cycle in conventional nylon. When Fosta Nylon 62 ASK was substituted, the cycle was reduced to 33 seconds, resulting in an 18% increase in production.

FOR THE PLUS IN PLASTICS, LOOK TO FG

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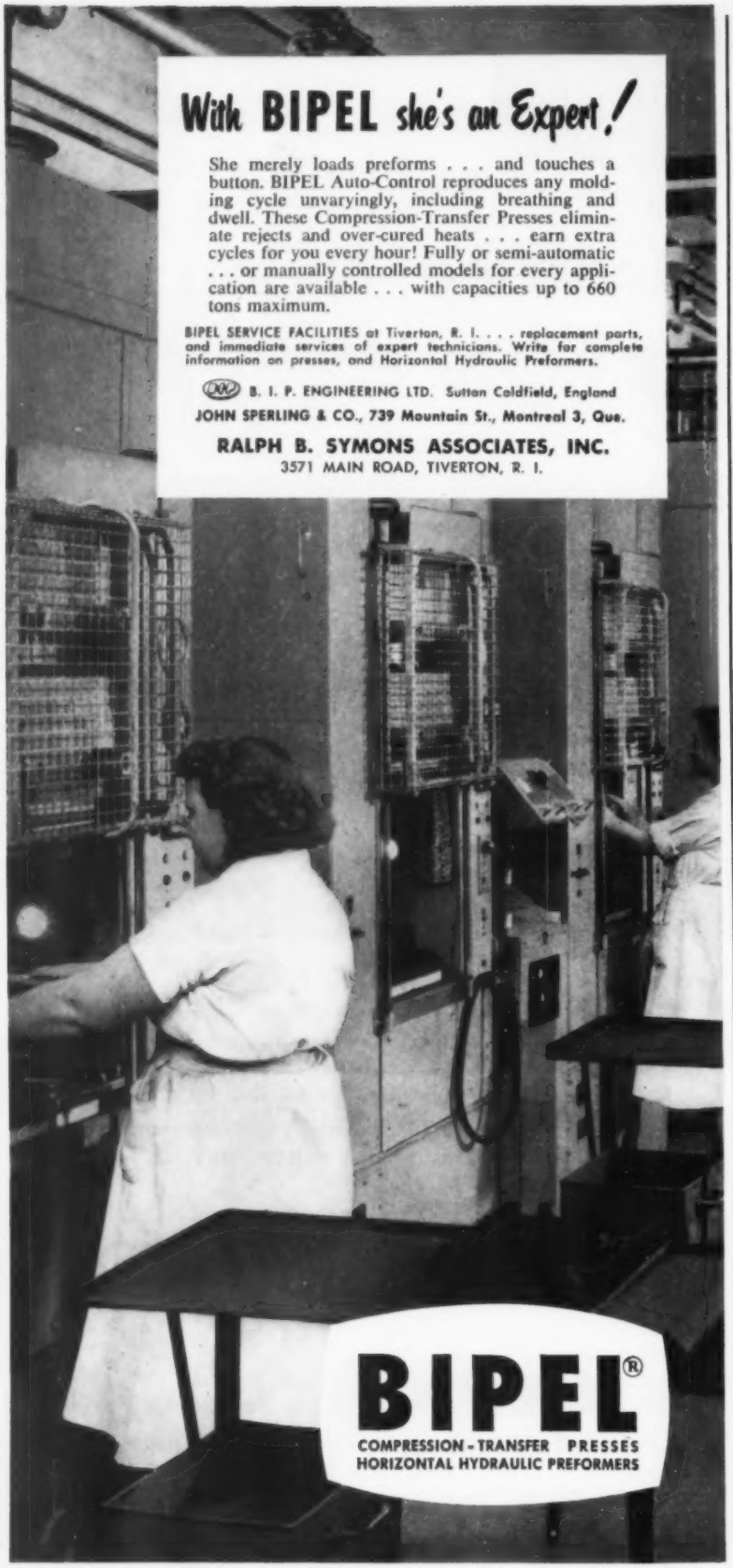
FOSTER GRANT ALSO MANUFACTURES PRODUCTION PROVED FOSTARENE POLYSTYRENE AND FOSTA TUF-FLEX POLYSTYRENE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She merely loads preforms . . . and touches a button. BIPEL Auto-Control reproduces any molding cycle unvaryingly, including breathing and dwell. These Compression-Transfer Presses eliminate rejects and over-cured heats . . . earn extra cycles for you every hour! Fully or semi-automatic . . . or manually controlled models for every application are available . . . with capacities up to 660 tons maximum.
BIPEL SERVICE FACILITIES at Tiverton, R. I. . . . replacement parts, and immediate services of expert technicians. Write for complete information on presses, and Horizontal Hydraulic Preformers.
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3571 MAIN ROAD, TIVERTON, R. I.
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COMPRESSION-TRANSFER PRESSES
HORIZONTAL HYDRAULIC PREFORMERS

THE PLASTISCOPE

(From page 218)

now distributed by Interplastics Corp., New York, N. Y. These materials can be supplied in all currently required formulations, in pellets or colorant blend.

Guarantees PE Pipe

A 20-year bond guaranteeing the performance of its SP polyethylene pipe in cold water service lines will be issued by Orangeburg Mfg. Co., Div. of The Flintkote Co. The bond, backed by a national surety company, guarantees, to the extent of the bond, that any repairs or replacements due to failure of the pipe will be made at the expense of Orangeburg.

According to the company, an exceptionally high molecular weight resin in SP Pipe gives it complete freedom from slitting or pin-holing, and makes it possible to guarantee the performance of the pipe, which is available in ½-in. to 2-in. sizes.

New companies

Custom Merchandise Corp., 43 York St., Brooklyn 1, N. Y., formed to manufacture all types of thermoformed products, but specializing in full-color display work and blisters for packaging. **Sheldon Oshin** is pres.

Sullivan Plastics, Inc., 77 River St., Hoboken, N. J., is a new manufacturing concern formed by **J. J. Sullivan,** formerly pres of Plasti-Foam Corp. The company will produce low-temperature insulation and will custom mold products from expanded polystyrene.

Polycraft Bag Co. will manufacture heavy-duty polyethylene bags for packaging industrial and agricultural products in a new plant in Mishawaka, Ind. Initial capacity for the plant will be 12 million bags a year.

The company will initially supply bags fully printed in up to four colors in 25- and 50-lb. sizes, in a wall thickness of 10 mils.

Formation of Polycraft Bag is an innovation in the bag-making industry, since it *(To page 222)*

GREEN SEAL

ALPHA EXTRUSION and MOLDING Compounds

Millions of pounds serving the manufacture of . . .
- Weather stripping and profiles
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- Molded products of all types

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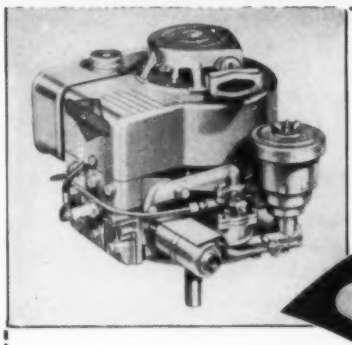
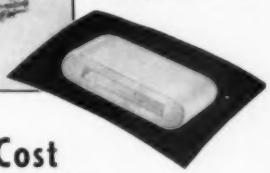


NO MOLD COST!



Reduced Unit Cost

on your initial run will effect savings for you that could very easily cover the cost of mold.

That is actually being done on many jobs similar to the starter pulley bumper (shown above) that SINKO molded for use on the Briggs and Stratton engine illustrated. Dupont ZYTEL was the plastic used because of its ability to resist wear, its quiet operation, and self-lubricating qualities.

Call on us when you're in need of Plastic Molded Parts . . . we'll produce them for you, accurately, speedily, and economically!

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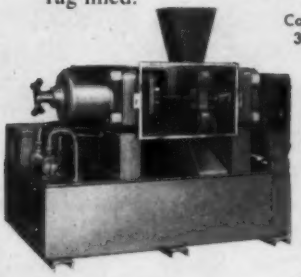
They may be used for handling the entire range of materials from G.P. phenolics to higher impacts that are rag filled.

Capacity range: 30 to 125 tons.



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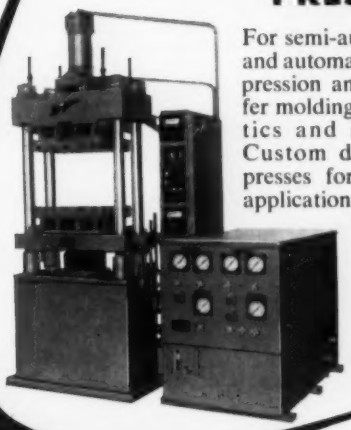
For semi-automatic and automatic compression and transfer molding of plastics and rubber. Custom designed presses for special applications.

Capacity: 10 to 400 tons.



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CARTER PRECISION GRADER

For *accurate* separating and sizing of plastic resins and other free-flowing granular materials—by *width* or *thickness*. Precision Graders separate by means of cylinders of unique designs with either round or slotted perforations. Various models and sizes—including multiple units—are available.

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For *accurate* separating and sizing by *length*. Carter Disc Separators vary in the number of discs and the size of the disc pockets. These pockets accurately lift material which is shorter, positively reject longer material. Laboratory demonstration tests are free.

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659 19th Ave. N.E. Minneapolis 18, Minn. STerling 9-2417

THE PLASTISCOPE

(*From page 220*)

is said to be the first company to manufacture heavy-duty, heavy-wall PE bags exclusively. The benefits of specialization include bringing the cost of the bag within the range of many specialty bag applications. Products which are packaged now in drums or barrels or special multiwall paper bags are potential markets for the Polycraft PE bag, according to the company.

James F. Wyllie, pres., and **Charles J. Foret,** VP, managed Nyloncraft, Inc., which is adjacent to the new plant.

Thermoplastic Equipment Corp., Stirling, N. J., has been established to design and build special machinery and equipment for the plastics industry, particularly for the extrusion process. **James M. Du Pont** is pres. The new firm is a subsidiary of **Thermoplastic Processes, Inc.,** extruders and compounders in the same city.

Coast Line Plastics Inc., 1315 E. 2nd St., Los Angeles 33, Calif., is a new entrant in the extrusion and injection molding field, with five extruders and two injection molding machines. **Hy Nadelberg** is VP and sales mgr.

Expansion

Busada Mfg. Corp., producers of clear butyrate pipe and tubing, has moved to a new plant at 32-21 Downing St., Flushing, N. Y., where the company will have five times the floor space previously occupied. Mr. Busada, head of the company, defines pipe as a tube, the dimensions of which conform to accepted standard pipe dimensions for which fittings are available—all inbetween material he classifies as tubing. According to this definition, the company now has butyrate pipe up to 4 in. in diameter and tubing up to 8 in. in diameter in stock. In addition to the above clear material the firm will now produce black butyrate pipe and tubing for conduits and Cycolac pipe for potable water systems.

K. Frank Larkin, Jr. is the firm's new assistant *(To page 224)*

FINEST PLASTIC CONTAINERS...

begin with Glidden Zopaque® Titanium Dioxide

The whiteness and brightness that gives bottles and other plastic containers greater eye-appeal, can best be achieved by the use of Glidden Zopaque Titanium Dioxide. Zopaque possesses outstanding optical properties — imparts high opacity, hiding power and tinting strength. And Zopaque is readily dispersible in plastic formulations.

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now for every size

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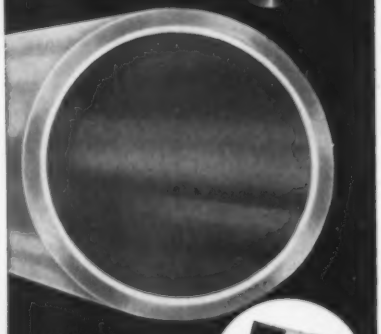

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THE PLASTISCOPE

(From page 222)

sales mgr. He was formerly with Lewis Shepard Products and also served as Eastern Div. sales mgr. for industrial coated fabrics manufactured by U.S. Rubber.

Union Carbide Corp. is building a plant to produce polyethylene film at Cartersville, Ga., about 40 miles northwest of Atlanta. The plant will be operated by **Visking Co.**, a div. of Union Carbide. In addition to polyethylene film, Visking also makes cellulose and plastics food casing. The plant is scheduled to be completed in July of this year. When in full production, it will employ about 100 people.

This will be the fourth plastics film plant operated by this div. of Union Carbide. Others are located at Fremont, Calif.; Terre Haute, Ind.; and Flemington, N. J. Visking's food casings plants are at Chicago, Ill., and Loudon, Tenn.

Peerless Plastics Co. has announced a $100,000 machinery modernization, marking the first step in a projected $250,000 expansion program.

Designed to provide an immediate increase of custom molding capacity by more than 50%, the new equipment includes the latest model 2½-oz. Van Dorn injection molder, a new Reed-Prentice $1\frac{2}{16}$-oz. machine, a $\frac{20}{28}$-oz. HPM injection molder, and a 150-ton transfer compression press. The company also plans to add personnel in research and development.

Whitehouse Chemical Co. will soon complete facilities at its Fort Worth, Texas, plant which will quadruple present output, and will provide a capacity of 30 million lb. of polyester resin annually. Custom formulating and blending is also available.

Vulcan Corp., Cincinnati, Ohio, one of the nation's largest producers of heels and lasts for the shoe industry, has entered the plastics field as an injection molder. The company has completed a 10,000-sq. ft. plant near existing facilities *(To page 226)*

YOU'VE ENOUGH WITH A KANE VERTICAL BOILER

Searching for more floor space in your shop or plant can be very perplexing and expensive . . . especially when some of the vital space is being occupied by an old fashioned, cumbersome, horizontal type boiler. More and more shop and plant supervisors are now finding out how a KANE VERTICAL BOILER PACKAGE produces even better results within a much smaller space.

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The KANE VERTICAL BOILER PACKAGE includes: the correctly sized Automatic Gas-Fired Boiler complete with gas burner and controls to maintain required steam pressure; and an M-K-O Automatic Boiler Feed system designed to return condensate and supply make-up water as required for highest operating efficiency.

Send now for full details in our new Bulletins No. 2L and No. 4H.

(Similar boilers are available for use with combination gas-oil . . . For pressures up to 350 lbs . . . Write for Bulletin No. 7D.)

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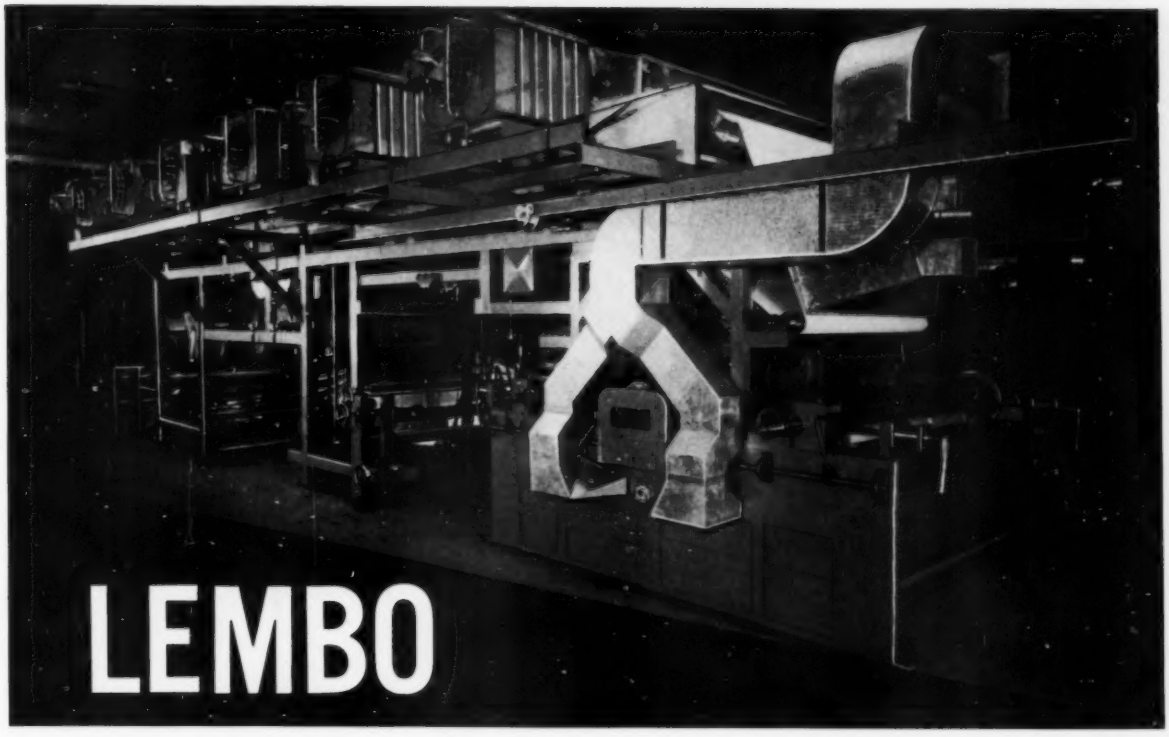

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- Heat and air circulation maintained between color impressions.
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- Tachometers at all critical work stations for stress-saving mechanical coordination.
- Equipped with choice of selective power or conventional drives.
- Available with hydraulic printing nip pressures to permit simultaneous backing away of all nips.
- Indexing units allow printing of narrower width film with simple indexing of impression roller.
- Machines available up to 6 color in gravure.
- New variable tension controller and aluminum slat expanders, also available as optional equipment.

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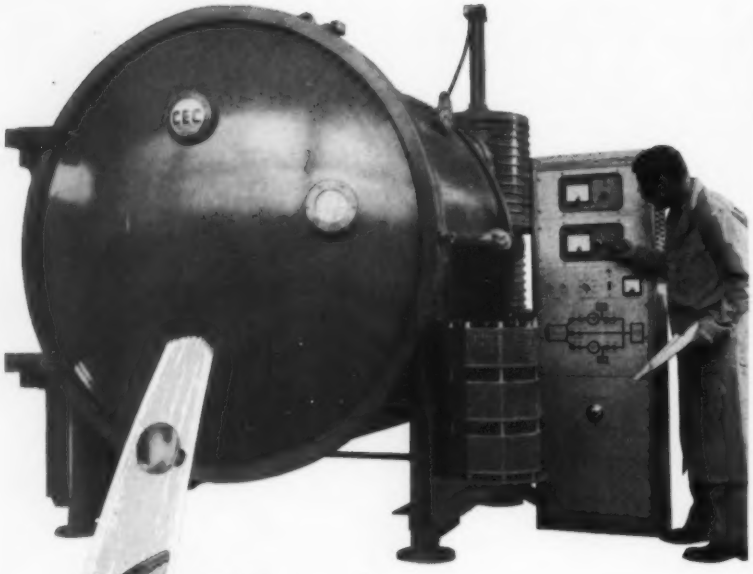
Manufacturers: PRESSES • EMBOSSERS • LAMINATORS • ROLLERS • *There is only one Lembo Machine! Be cautious of "Lembo-Type" imitations.*



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THINK BIG for BIGGER PROFITS in METALLIZING

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But there's much more than volume capacity to the profit story. With CEC coaters of any size, you'll find that actual coating costs are lower than by any conventional method. A dime's worth of most metals will do thousands of pieces. Easy to use, too; no skilled help needed, no profit-consuming training programs.

And you profit from uniform high quality. Surfaces metallized in a CEC coater are so bright and gleaming that they need no buffing or polishing. New long-life lacquers, low in cost and easy to apply, keep them that way.

Write for application data and specifications on the complete CEC line. Just ask for Metallizing Bulletins.

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Rochester Division, Rochester 3, N.Y.

SALES AND SERVICE OFFICES IN PRINCIPAL CITIES

THE PLASTISCOPE

(From page 224)

at Portsmouth, Ohio. Initial production will be confined to plastic shoe heels, and capacity is in excess of 500,000 pairs per month. Later, attention will be directed to other plastics shoe components or other plastics products.

Filon Plastics Corp. has acquired a 9-acre site for a new $1 million plant in Hawthorne, Calif., which, the company states, will be the world's largest factory devoted exclusively to the production of fibrous glass translucent building panels.

The 70,000-sq. ft. facilities will serve as the national headquarters and will bring the various departments of the company under one roof. Filon will continue to operate its regional warehouses and sales offices.

National Vulcanized Fibre Co. acquired **Parsons Paper Co.**, Holyoke, Mass., which will become the **Parsons Paper Div.** of National. Parsons manufactures bond, ledger, and index bristol papers and paper specialties.

Extrudo-Film Corp. has begun construction of a 50,000 sq. ft. plant in Pottsville, Pa., that will quadruple its present capacity to produce polyethylene film, sheet and tubing; and will house expanded research and technical service facilities. Production is expected to begin in May, 1959.

Reynolds Metals Co. has installed a new high-speed Egan polyethylene coating machine at its Richmond, Va., plant. The unit has a 6-in. extruder with 20/1 length-to-diameter ratio, will take webs up to 44 in. wide, and has a turret type flying splice rewind capable of speeds up to 1000 ft./min. It is designed to handle paper and foil, and to make sandwich laminates. The company also has installed a laboratory extrusion coating line with a 2½-in. Egan extruder.

Industrias Plasticas Argentinas Koppers, S. A., (IPAK), in which **Koppers International C. A.**, has a substantial inter- *(To page 228)*

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COMPANY

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THE MEARL CORPORATION
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124 East 40th Street, New York 16, N. Y.

THE PLASTISCOPE

(*From page 226*)

est, plans to build a $17 million ethylene and polyethylene plant near Buenos Aires, Argentina. Annual production is expected to be in excess of 15 million pounds.

The plant will go into service during 1961, and will be the first to make use of gases from Argentine refineries, which are now being wasted.

IPAK also proposes to construct a styrene monomer plant near Buenos Aires, with a capacity of approximately 15,000 metric tons per year, at a cost of about $7.5 million. It will supply raw material for the polystyrene plant already operating in the Argentine, and will have sufficient capacity to supply styrene monomer for the manufacture of synthetic rubber in the Argentine.

Haveg Industries, Inc., Wilmington, Del., has installed a new 2000-ton press for use in the manufacture of plastics rocket, missile, and space vehicle components. This press, with 12 ft. of daylight, can make such parts as blast tubes, adapters, insulation, nose cones, jet vanes, jetevators, exit cones, and many other structures of molded plastics. Materials fabricated in this press operate from 2000 to 20,000° F.

The company also expanded facilities for manufacturing of components up to 20 ft. in length by installation of additional processing facilities for filament winding and spinning of pressure vessels and missile cases.

Deceased

Clarence W. Coe, a Plastics Pioneer, and most recently manager, **Stonington Div., Plax Corp.,** died Feb. 28, following an operation.

L. B. Turner, 55, associated with the development of polymers and other petrochemical products for **Enjay Co., Inc.** for the last 27 years, died March 5.

Meetings

Plastics groups

May 5-22: Technical Society of Plastics in Japan, 1959 Tokyo International Trade Fair, Plastics Hall, Harumi Trade Fair Grounds, Tokyo, Japan.

May 7: Society of Plastics Engineers, Inc., Pittsburgh Section. Penn-Sheraton Hotel, Pittsburgh, Pa. Regional Technical Conference. Subject: "Plastics and the Metal Industry."

May 8: Society of Plastics Engineers, Inc., Western New England Section, Bradley Field, Terrace Dining Room, Windsor Locks, Conn. Film together with a discussion on plastics applications utilizing controlled air power equipment.

May 22: Society of Plastics Engineers, Inc., Northern Indiana Section, Fort Wayne, Ind. Subject: "Plastics in Electrical Insulation."

June 17-27: International Plastics Exhibition & Convention (formerly British Plastics Exhibition & Convention), Olympia, London, England.

Other meetings

May 1: University of Akron. Akron Polymer Lecture Group, Room 107, Knight Hall, University of Akron, Akron, Ohio. Subject: "Plastics Can Be Tough."

May 11-13: American Management Association, AMA headquarters, New York, N. Y. Seminar on packaging with polymeric materials.

May 17-21: National Toy Show, Morrison Hotel, Chicago, Ill.

May 20: American Chemical Society, New York Section, Lower Mezzanine Dining Hall, Union Carbide Corp. Bldg., 30 E. 42nd St., New York, N. Y. Lecture: "Challenges in marketing for the Coming Decade—Plastics."

May 20-21: Chemical Market Research Association. Annual Meeting. Plaza Hotel, New York, N. Y.

May 25-27: Technical Association of the Pulp & Paper Industry, 10th TAPPI Coating Conference, Statler Hotel, Boston, Mass.

May 25-28: American Society of Mechanical Engineers, 4th Annual Design Engineering Show. Concurrent conferences. May 26: "Latest Developments in Plastics for High Temperature Service." Convention Hall, Philadelphia, Pa.—END

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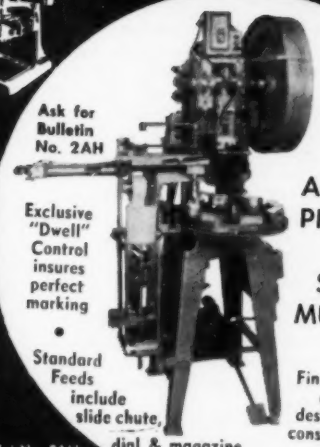

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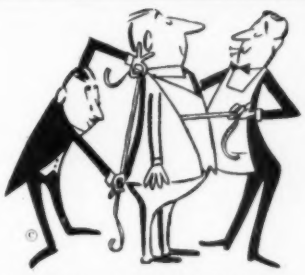


SEALING EQUIPMENT for SHEET PLASTICS

Although the standard line of Mayflower heat sealing devices has the broadest application in the sheet plastics industry, our engineers take special satisfaction in meeting the problems of the "hard to fit" manufacturer. If your specifications for plastic seals affect production goals adversely, we should welcome the opportunity of consulting with your production people.

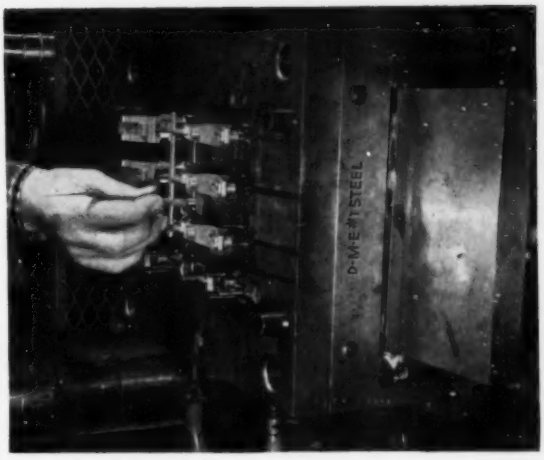
Mayflower ELECTRONIC DEVICES Inc.

Only Manufacturer of both Bar and Rotary Electronic Heat Sealers

HUbbard 9-9400

20 Industrial Avenue — Little Ferry, N. J.

6,000 COMBINATIONS



YOU SAVE MORE ON MOLD COSTS WITH OVER 6,000 D-M-E STANDARD MOLD BASES TO CHOOSE FROM

Whether it's a one-cavity "test" mold or a 60-cavity high production run, chances are D-M-E has the right size Standard Mold Base to fit the job and the molding machine.

D-M-E's 32 standard sizes, up to 23¾" x 35½", with 100 standard cavity plate combinations for each size, give you the largest selection of carbon or alloy steel standards available from any single source.

Save on Design and Moldmaking Time, Replacement Parts and Delivery

Design time is reduced by using D-M-E's full-scale Master Layouts and Catalog of specifications and prices. Moldmaking time is reduced because all D-M-E plates are precision ground flat-and-square, ready for cavity layout and machining. Exclusive interchangeability gives you the added saving of immediate replacement of any component part. And D-M-E's seven branch offices and warehouses are always fully stocked with Standard Mold Bases and components to meet your delivery requirements.

Cut Costs on Your Next Program

Start saving on your next moldmaking program, no matter how large or small. Take advantage of D-M-E Quality, Service and Economy.

Faster deliveries from complete stocks

Over 1,000 D-M-E Standard Mold Bases always IN STOCK at local D-M-E Branches for IMMEDIATE DELIVERY.

DME DETROIT MOLD ENGINEERING COMPANY

- DETROIT: 6686 E. McNichols Rd.—CHICAGO: 5901 W. Division St. HILLSIDE, N.J.: 1217 Central Ave.—LOS ANGELES: 3700 S. Main St.
- D-M-E CORP., CLEVELAND: 502 Brookpark Rd.—DAYTON: 558 Leo St.
- D-M-E of CANADA, Inc., TORONTO, ONT.: 156 Norseman Ave.

COMPANIES...PEOPLE

Appointments, promotions, and relocations in the plastics industry.

Hooker Chemical Corp.: Dr. Chris A. Stiegman named to corporate position of dir. of research. **Dr. J. Howard Brown,** formerly gen. mgr. of R & D at Hooker's Niagara plant, now gen. mgr.—chemical research. **Dr. Alvin F. Shepard** promoted from resident dir., LeRoy, N. Y., laboratory of **Durez Plastics Div.,** to gen. mgr.—plastics research. **James S. Sconce** named tech. asst. to the dir. of research. **Carl I. Gochenour** appointed gen. mgr.—product development, and **Dr. Thonet C. Dauphiné,** formerly mgr. of product development—plastics, now with the general development dept., specializing in economic development.

Celanese Corp. of America: J. Stewart Campbell named mgr.—laboratory services; **Dr. Michael J. Curry** appointed mgr.—plastics research dept.; and **Dr. William J. Evers** is mgr. of the newly created exploratory polymer research dept.; at the company's central research laboratories, Summit, N. J.

Chicago Molded Products Corp. appointed the following mfrs. reps.: **Stetler & Stetler,** Buffalo, N. Y.—N. Y. State, excluding New York City; **Art Sawyer & Assocs.,** Detroit, Mich.—"Big Three" automotive companies and subsidiaries; **John Webb, Southern Dynamics, Inc.,** Orlando, Fla.—Ala., Ga., and Fla.

Matthew J. Warden named direct salesman of the **Campco Div.** and will headquarter in Chicago, Ill.

The Dow Chemical Co.: Frank J. MacRae named mgr.—plastics tech. service. **Thomas M. Gow** appointed mgr.—Cleveland, Ohio, sales office.

U. S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp.: Clifford E. Oman appointed gen. mgr. of the petrochemical plant-complex at Tuscola, Ill.

Kenneth Fietz named mgr. of the new U.S.I. sales office at 220 Montgomery St., San Francisco 4, Calif.

Allied Chemical Corp., Plastics & Coal Chemicals Div.: Byron R. Wardle named marketing supv.—Plaskon plastics and resins. **William E. Morris** made product supv.—Plaskon phenolic resins.

Cadillac Plastic & Chemical Co. opened a new warehouse-sales branch at 6426 Long Dr., Houston, Texas. **Robert Prochnow** named mgr.

B. F. Goodrich Industrial Products Co.: Thomas G. Vest named to handle sales development work on Koroseal vinyl upholstery and wall covering materials at the Marietta, Ohio, plant. **Arthur R. Edwards** appointed Chicago, Ill., sales rep. for the **Plastic Products Div.**

Foster Grant Co., Inc.: Dr. David K. Eads named supv. of the chemical engineering process development section of the research laboratories. **Dr. Leo W. Ziemlak** will handle tech. information processing at the R & D laboratories.

Union Carbide Corp.—Visking Co.: Dr. W. F. Underwood named dir. of research, and **J. C. Wright** is dir. of development.

Union Carbide Chemicals Co.: Rolf V. Wallin appointed VP—engineering.

Stokes Molded Products, div. of Electric Storage Battery Co.: Robert Kent appointed asst. gen. mgr. **Martin Sessa** named office sales mgr.

Stauffer Chemical Co., Molded Products Div.: Thomas A. Williams appointed asst. gen. mgr.; **W. S. Gillon** named plant mgr.; and **William K. McPherson** is prod. mgr.

Marblette Corp., Long Island City, N. Y., opened an office at 5655 W. North Ave., Chicago, Ill., staffed by **Robert Ross** and **James Brock.**

R. S. & W. Industries, Pekin, Ill., will work with the Chicago office as distributor for Maraset epoxy resins and other Marblette products.

National Polychemicals, Inc., Wilmington, Mass., formed a new Plastics Div. **Dr. Leopold F. Bornstein** named a VP and gen. mgr. of the div. **John C. Blackwood** appointed to exec. sales staff of the company.

Avery Adhesive Products, Inc., Monrovia, Calif., is the new combined corporate name of **Avery Adhesive Label Corp.,** and **Fasson, Inc.** Each will continue to operate as divs. of the corp. under the new names of **Avery Label Co.** and **Fasson Products.**

Automold Co. is the new name of **Automatic Molding Machine Co.,** subsidiary of **Wagner Bros., Inc.,** Detroit, Mich. The company moved its plant from 400 Midland, Detroit, to 2231 South Butler Ave., West Los Angeles, Calif.

Alpine American Corp., 69 Nicholas Rd., Saxonville, Mass., is the new name and address of **Alpine-Lukens Corp. Lukens Laboratories, Inc.,** 227 California St., Newton 58, Mass., sold its interests and ceased all connections with the Alpine machinery agency. **Dr. W. H. Gellrich** and **Walter J. Norton** remain as tech. dir. and VP—sales, respectively.

R. H. Windsor, Ltd. and its affiliated companies, **Klaxon, Ltd.** and **Webley & Scott, Ltd.,** opened new showrooms and offices at 76 Jermyn St., London S. W. 1, England.

Society of Plastics Engineers, Inc.—National Vinyl Professional Activities Group: Robert Abeles, Elfskin Corp., elected chrmn., **Saul Gobstein, Ferro Chemical Corp.,** is vice-chrmn., and **Joseph Clancey, Emery Industries, Inc.,** named secy.

N. Y. Section: Herb Weber, The Rotuba Extruders, Inc., Div. of Waljohn Plastics, Inc., elected pres. of the section.

Dal-Vir Products, Inc., Elkhart, Ind., appointed custom fabricator of pipe and fitting covers with Styrofoam, expanded polystyrene made by **The Dow Chemical Co.**

Stein Equipment Co., 107-8th St., Brooklyn 15, N. Y., named sole U. S. reps. for **S. R. Seymour & Co., Ltd.,** Rayleigh, England, mfrs. of bench model injection molding machines.

S.P.I.—Reinforced Plastics Div.: Harriet Raymond, Celanese Corp. of America; Robert J. Brinkema, Firmaline Products, Inc.; and **Leonard S. Meyer,** consultant, received the 1958 Exec. Committee Awards.

Century Dispersions, Inc., Detroit, Mich., is the new name of **Century Products Co.,** mfrs. of color dispersions.

Hastings Plastics, Inc. named a marketing outlet for **Reichhold Chemicals, Inc.** for its polyester and phenolic resins in southern Calif.

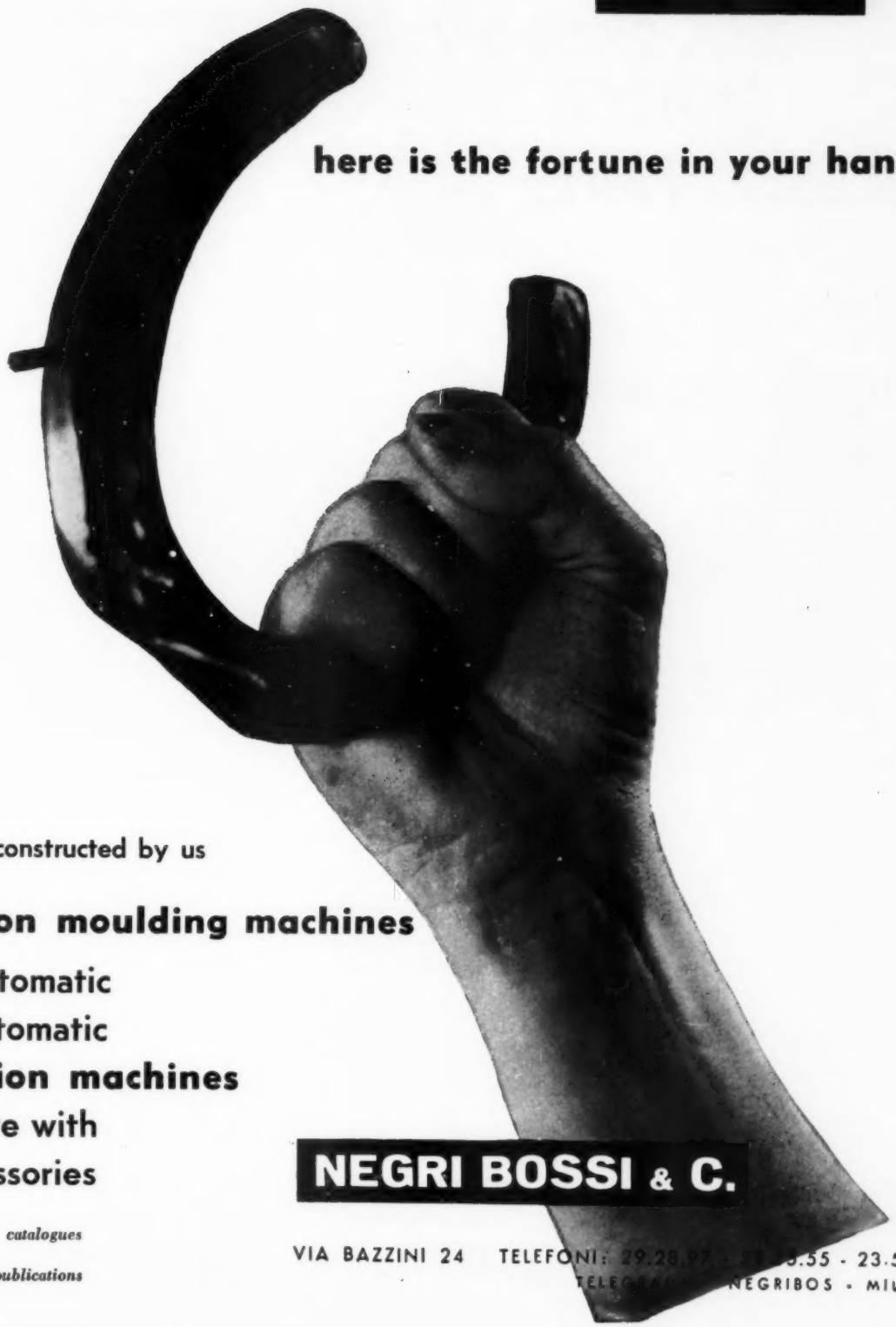
Plastomatic Corp., Malvern, Pa., custom injection molder, appointed the following mfr.'s reps.: **William G. Wright,** 6600 W. Franklin St., Richmond, Va.; **M. H. Nooning, Jr., & Assocs.,** 603 Whitney Ave., Pittsburgh, Pa.; **Ronald L. Nulick,** 126 E. 203 St., Cleveland, Ohio.

Celluplastics Corp.: James L. McKenna named asst. sales mgr., **Gus Johnson** is field sales mgr.

Summers Electric Co., Inc., Dallas, Texas, appointed a distributor for **Continental-Diamond Fibre Corp.,** Newark, Del., which is a subsidiary of **The** (*To page* 232)

NB&C

here is the fortune in your hand!



machines constructed by us

Injection moulding machines

semi automatic
fully automatic

Extrusion machines

complete with
all accessories

ask for our catalogues
and technical publications

NEGRI BOSSI & C.

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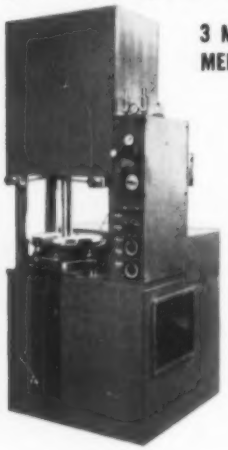
TELEGR[illegible] NEGRIBOS · MILANO

HEAT SEAL *odd shaped* MOLDED PLASTIC PARTS

Heart, diamond, spade, club and many other configurations of molded plastic parts can now be permanently heat sealed at production speeds using Cosomatic Sealing machines. This patented process and these machines save many companies thousands of dollars . . . solve sealing problems you might have thought impossible.



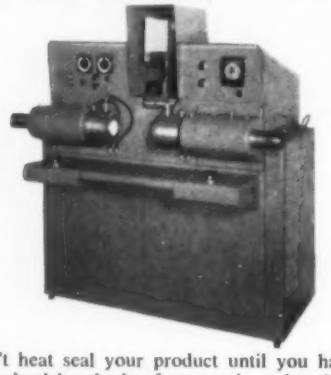
3 MODELS — 16 SIZES — DESIGNED TO MEET NEARLY EVERY SEALING REQUIREMENT

If you have a problem sealing molded plastic parts then it's time you checked Cosomatic sealing equipment. If you are not already familiar with these machines then you're in for a pleasant surprise. They seal permanently, automatically and without the use of adhesives. Cosomatic machines are not spin sealing machines and they are adaptable to a wide variety of size and shape requirements. All machines are designed for heat sealing all thermoplastic materials.

COSOMATIC VERTICAL SEALER — This unit is designed especially for sealing large parts which are vastly disproportional in size, which in many cases, prohibits the use of any standard sealing arrangement. This model is successfully being used today to seal some of the most unusual types of molded plastic parts you have ever seen. The machine design eliminates alignment problems on oversize or overhang. Sealing chucks have vacuum holding devices and the entire sealing cycle is completely automatic. Speed of operation depends upon size of product being sealed and the relative convenience of loading and unloading.

MODEL S-308-8 COSOMATIC SEALER

This machine opens a whole new field of applications for polyethylene and other thermoplastics. It is now being used for sealing toys, sporting goods, domestic and chemical containers, housewares, etc. Finished parts or products are uniform in wall thickness at point of sealing and are permanently sealed. This model seals 5 to 10 parts per minute. Also available . . . high speed rotary models . . . will seal up to 1800 units per hour.



Don't make up your mind that you can't heat seal your product until you have talked to Cosom Engineering. We have helped hundreds of companies solve their sealing problems, efficiently and economically. If you want improved sealing or are planning a new sealing operation, send us your part, drawing and particulars. We will submit recommendations and literature on the Cosomatic Sealer for your requirements. For complete information write today.

THE COSOM ENGINEERING CORP.

6016 Wayzata Blvd. • Minneapolis 16, Minnesota

National Representatives: THE RAINVILLE COMPANY
657 Franklin Avenue, Garden City, N. Y.
Offices in Principal Cities

COMPANIES...PEOPLE

(*From page 230*)

Budd Co. Summers will stock the complete CDF line of laminated plastics, vulcanized fibre, and other insulating materials.

Resin Research Laboratories, Inc., Newark, N. J.: **Dr. Gerald A. Baum** joined the firm as sr. chemist and **Ronald Saltzman** as assoc. chemist.

David H. Bechtold appointed a tech. sales rep. for plasticizer sales for **Monsanto Chemical Co.'s Organic Chemicals Div.** at St. Louis, Mo.

Harry H. Balthaser elected pres. of **Fome-Cor Corp.,** a company formed recently by **Monsanto Chemical Co.** and **St. Regis Paper Co.** He was formerly admin. asst. to the dir. of marketing of Monsanto's Plastics Div., Springfield, Mass.

Dr. H. Bunde has arrived in New York, N. Y., to take over his duties as a technical and scientific rep. in the U. S. for Farbwerke Hoechst AG., as well as to assume the position of VP of **The Uhde Corp.** of New York. Dr. Bunde, in these capacities, is the successor to **Dr. Hans Hoyer,** who is returning to the home office of Farbwerke Hoechst AG. in Frankfurt-Hoechst, West Germany.

L. C. Keller appointed sales engineer in the plastics dept. of **The Goodyear Tire & Rubber Co.'s Chemical Div.** He will be responsible for sales service activities connected with Pliovic vinyl dispersion resins.

Roy Carson promoted from sales mgr. to the newly created post of asst. to the pres. of **Chippewa Plastics, Inc.,** recently purchased by **Rexall Drug Co.** He is succeeded by **Robert F. Hrudka,** who was also made a VP.

Joseph Meyer appointed sales rep. in N. J. and metropolitan N. Y., for **Auburn Plastics, Inc.**

Edwin K. McClellan named sales rep. in the Cleveland, Ohio, office of the plastics div., **Eastman Chemical Products, Inc.**

Robert W. Wheatcroft named sr. supv. in the planning div. of **Du Pont's** Polychemicals Dept.

John J. Meyer appointed exec. VP, **Great American Plastics Co.,** Fitchburg, Mass.

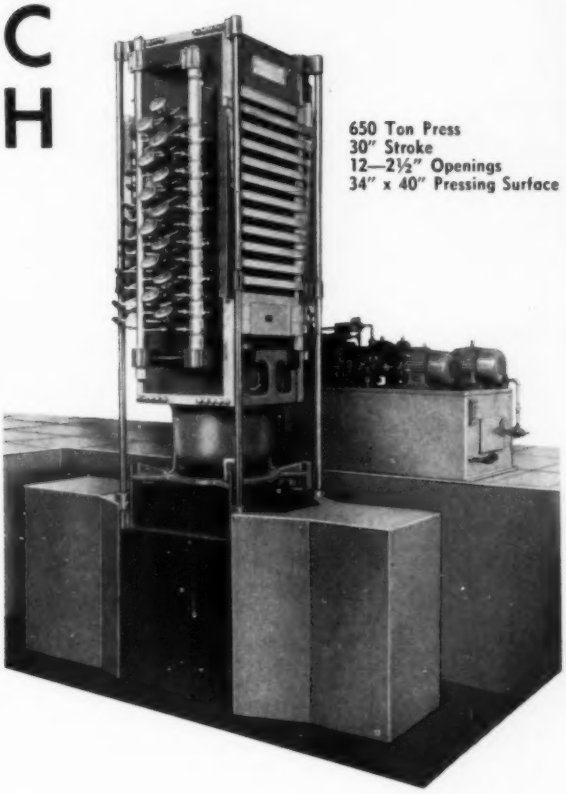
Robert L. Berwick appointed PVC plastic sales engineer in **A. M. Byers** Co.'s southeastern div., with headquarters in Atlanta. Ga.

John S. McClintock named dir.—marketing & sales, **G. T. Schjeldahl Co.,** Northfield, Minn who are mfrs. of ma-

(*To page 234*)

FRENCH

Hydraulic Presses for Printed Circuit Work, Too!



650 Ton Press
30" Stroke
12—2½" Openings
34" x 40" Pressing Surface

High-output presses for the rubber and plastic industries have been French's specialty for over 50 years. Let our engineers consult with you . . . send us your pressroom requirements today.

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HYDRAULIC PRESS DIVISION
REPRESENTATIVES ACROSS THE NATION:
Boston — New York — Cleveland — Chicago — Denver
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THE FRENCH OIL MILL MACHINERY CO.
Piqua, Ohio

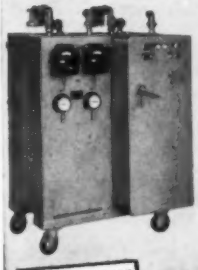
NEW
from
Sterlco®

A SINGLE ZONE HIGH TEMPERATURE CONTROL UNIT

- accurate
- automatic
- versatile
- compact

Model 6016 Single Zone Circulating Unit.

All of the features of this new STERLCO unit are designed to give the most efficient and economic high temperature control possible . . . yet compact enough to be completely portable so that it may be set into immediate use anywhere. This unit provides exacting control of temperature automatically at any desired pre-set temperature from 100° to 550° F (the current limitation of available heat transfer fluids). If cooling is required, either manual or automatic cooling controls can be provided. STERLCO units are completely self-contained and, by simply connecting to an electrical source and setting up, they will operate continuously without supervision. Several units may be assembled on a single base to provide a range of separately controlled heat zones, if desired.



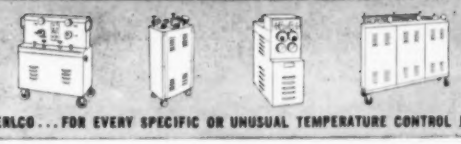
The New Model 6007 Dual Zone Circulating Unit is also a compact, portable, oil circulating unit containing two completely separate systems for the maintenance of independent temperatures simultaneously.

Send for Bulletin 557

EXPORT: Omni Products Corporation, 460 Fourth Ave., New York 16, N. Y.

MANUFACTURERS OF TEMPERATURE CONTROL EQUIPMENT SINCE 1916

INDUSTRIAL CONTROL DIVISION
STERLING, INC.
5206 W. Clinton Avenue • Milwaukee 18, Wisconsin



STERLCO . . . FOR EVERY SPECIFIC OR UNUSUAL TEMPERATURE CONTROL JOB

Get your ***full measure*** *of performance*

in nylon molded parts

...specify NYLATRON® GS molding powders

Property-for-property, NYLATRON GS (molybdenum disulphide filled nylon*) outperforms ordinary nylon moldings. A check of the following points will show why you can produce a superior product and at the same time simplify engineering, step-up design accuracy, meet precise specification—and cut costs:

Higher heat resistance—Tests show the following superiority:

Heat Distortion	*NYLATRON GS*	*Unfilled nylon*
66 psi	450°F.	360°F.
264 psi	325°F.	200°F.

Superior dimensional stability—With a coefficient of linear thermal expansion approximately half that of nylon, NYLATRON GS provides more accurate molding tolerances, better size control, reduced dimensional changes after molding.

Greater crystallinity—Makes NYLATRON GS molded parts more rigid. Parts have higher resistance to deformation under load, exhibit less creep.

Increased wear resistance—As a dry bearing NYLATRON GS can often be used at higher pressure and velocity ratings.

Improved strength—Modulus of elasticity more than 40% greater, flexural and tensile strength are increased compared to unfilled nylon.

Better moldability—Self-lubricating qualities of NYLATRON GS reduce need for mold lubrication, are easily ejected. Distortion after molding is minimized.

Write today for new descriptive bulletin of technical data on NYLATRON GS. Helpful information on molding NYLATRON GS is also available.

Visit Polymer Booth No. 315
Design Engineering Show, Philadelphia
May 25 to 28

NATIONAL POLYMER PRODUCTS, INC.
Reading, Pa.

A subsidiary of The Polymer Corporation, Reading, Pa.
Export: Polypenco, Inc., Reading, Penna., U.S.A.

*Composition and use for machine parts are covered by U.S. Patent No. 2,855,377.

POLYPENCO®

COMPANIES...PEOPLE

(*From page* 232)

chines, accessories and attachments for making polyethylene bags, and makers of polyester balloons, tank liners, floatation units, and other custom-made polyester products.

William Page named plastics engineer of **Des Moines Design & Engineering Co.**, Des Moines, Iowa. He will handle design, product and tooling, and also act as consultant for the company.

Neil F. Putnam elected VP—engineering, **Improved Machinery, Inc.**, Nashua, N. H.

Joseph D. Needles appointed sales mgr., **Bell Boy Boat Div., Lunn Laminates, Inc.**, Huntington, N. Y.

Ferd Muller named eastern U. S. sales rep. of **Falls Engineering & Machine Co.**, Cuyahoga Falls, Ohio.

Arnold A. Weiner to direct newly coordinated centralized sales of vinyl upholstery materials for **The General Tire & Rubber Co.'s Textileather Div.**, Toledo, Ohio; **Jeannette Div.**, Jeannette, Pa.; and **Bolta Products Div.**, Lawrence, Mass. He will headquarter at Lawrence.

George C. Kroening appointed VP—sales for the **Northern Plastics Corp.**, La Crosse, Wis., and its wholly-owned subsidiary, **Norplex Fabricators, Inc.**, Black River Falls, Wis.

Claude L. Alexander appointed VP and gen. mgr. of **American Can Co.'s Bradley-Sun Div.**, which produces plastic and collapsible metal tubes and other products.

Raymond F. Ouer named gen. mgr. in charge of sales of **Rieke Metal Products Corp.**, Auburn, Ind. The company specializes in the manufacture of plastic and steel closures for steel shipping containers.

Charles J. Smith appointed mgr. of the newly formed plastics dept. of **The Bryant Electric Co.**, Bridgeport, Conn.

Elo Blomquist appointed mgr. of plastics div. sales, **Walworth Co.**, New York, N. Y. He succeeds **Sidney A. Lewis**, now mgr. of tech. sales service.

Robert E. Lally named mgr. of the laboratories of **Metasap Chemical Co.**, a subsidiary of **Nopco Chemical Co.** He will be responsible for research, development, and tech. service concerned with vinyl stabilizers and metallic soaps.

Dr. J. R. Weschler joined the Structural Resins Laboratory of **Ciba Products Corp.**—END

CLASSIFIED ADVERTISEMENTS

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and Equipment for sale

JUST SECURED —Most Modern Packaging and Processing Machinery—Available at Great Savings Hayssen Model F Compaks with net weight scales, bulk and dribble feeds, Electric Eyes. Ceco Model 40-9½-GG Automatic Adjustable Cartoning Units. Also Model TT. Package Machinery, Hayssen, Scandia, Wrap King, Miller Wrappers. Pneumatic Scale Automatic Carton Feeder, Bottom Sealer, Wax Liner, Top Sealer with interconnecting Conveyors. Pneumatic Scale Tite Wrap. Fitzpatrick Model D-6 Stainless Steel Comminuters. Day, Robinson 50 to 10,000 lb. Dry Powder Mixers. Warner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers. Baker Perkins, from 2 to 100 gal. Double Arm Mixters. Jacketed and Stainless Steel. Stokes DD2 and Eureka Tablet Machines. Complete Details and Quotations Promptly Submitted. Union Standard Equipment Co., 318-322 Lafayette St., N.Y. 12, N.Y. Phone: CAnal 6-5334.

FOR SALE 5—Unused Baker Perkins size 15 JIM2, 100 gal. steam jacketed double arm Mixers; 1—Baker Perkins size 16 TRM, 150 gal double arm Mixer; 1—Ball & Jewell #1 Rotary Cutter; 1—Kent 6" x 14" three roll Mill; 6—Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 4—Stokes Model "R" single punch Preform Presses. Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment. Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

FOR SALE: Ovens, Grinders, Powder Mixers, Injection Molding Machines 1 oz. to 60 ozs. never used and used. Two-head Bottle Blowing Machine. Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900, 102 Grove Street, Worcester, Mass. PLeasant 7-7747. 5222 W. North Ave., Chicago, Ill. TUxedo 9-1328.

FOR SALE: H.P.M. Rubber Injection molders, 21½"x28" mold space, steam heated platens. Watson-Stillman 300 ton semi-automatic compression molding press (1947) self-contained mold size 34"x27". Watson-Stillman 250 ton 28"x24". Watson-Stillman 140 ton 22"x16". Waterbury Farrel 85 ton 20"x24". W.F. 63 ton 15"x15". Laboratory presses—15 ton 10"x 8" and 10 ton 6"x6" platens. (2) 8 ounce Reed Prentice injection molding machines and (1) 8 ounce Lester Phoenix (late) with nylon attachment. Scrap cutters, valves, accumulators. Hydraulic Presses—all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

MACHINERY AND EQUIPMENT—FOR SALE: One or two used Watson Stillman 16 oz. injection moulding machines, late type, fully equipped, in excellent operating condition, with or without spare parts, can be seen in operation. Reply Box 5402, Modern Plastics.

FIRST CLASS EQUIPMENT FROM YOUR FIRST SOURCE: 2 Roll Mills: 30", 42", 60" Heavy Duty Jacketed Mixers Dbl. Arm: Baker Perkins in all sizes Lab. to 300 Gal.; Dbl. Ribbon Blenders all sizes; Tumbling Cone Mixers to 300 cu. ft.; Rotary Cutters Plastics-Rubber; National Erie 6"x66" Extruder; Preform Presses by Stokes, Colton, Kux. Inquire about the FMC Rental-Purchase Plan. Equipment pays for itself. First Machinery Corp., 209-289 Tenth St. Bklyn. 15, N.Y., STerling 8-4672.

TABLET PRESSES: 2-Stokes Model DDS2 rotary tablet presses with drives, $3,000.00 each. Reply Box 5421, Modern Plastics.

FOR SALE: Baldwin-Southwark 200 ton semi-automatic transfer molding press. 2500 ton downstroke 54" 102". French Oil 250 ton 38"x28". 200 ton hobbing press. 200 ton 16" record presses. French Oil 120 ton self-contained. Hydraulic pumps and accumulators. New ¾ oz. Bench Model Injection Machines. Van Dorn 1 to 2½ ounce. Lester 16 oz. & Reed 22 oz. Other sizes to 100 oz. Baker-Perkins and Day jacketed mixers. Bail & Jewell #2 Plastic Grinders & other sizes. Oxford 60" slitter. Seco 6" x 12" and 8" x 16" mills and calenders. Hartig 3½" Plastic Extruder, MPM 2" & NRM 1". Thropp 3" x 8" Lab. two roll Plastic Mill. Single & Rotary preform presses ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107-8th St., Brooklyn 15, New York.

SALE—One Model Reed Prentice 175T 4 to 6 oz. Automatic Injection Molding Machine; practically new, 2 years old—run 1/3 time. Principals only. Reply Box 5422, Modern Plastics.

FOR SALE: 8 oz.—10D-8 Reed Prentice Injection Molding Machine. 1952 model. Excellent Condition. In operation at U. S. Plastic Company, Pasadena, California. Telephone RYan 1-9361.

FOR SALE: 4 self-contained compression molding presses 470, 300, 250 tons; 1 Defiance #20 preform press, M. D.; 1—100 cu ft jacketed steel ribbon blender. M. D.; 1—22"x60"—2 roll plastics mill. M. D.; 3 Cumberland #0, #½ granulators; also extruders, mixers, presses, etc. Chemical & Process Machinery Corp., 52 9th St., Brooklyn 15, N.Y., HY 9-7200.

FOR SALE: Two 150 ton Stokes Presses, preform machines, staple & fancy button dies, various gas fired boilers up to 10 HP, single motor Pondorfs. Write Merit Plastics, 30 Lincoln Place, Lynbrook, New York.

FOR SALE: 16 Plastic Injection Molding Machines (12) 8 oz. Reed-Prentice; (1) 9 oz. H.P.M.; (2) 12 oz. Watson-Stillman; (1) 28 oz. Watson-Stillman, Lafayette Machinery Co., 5454 Bellevue, Detroit 11, Michigan or Bedford-Bolling Co., Inc., 3190 East 65th St., Cleveland 27, Ohio.

SPECIALS: 16 oz. HPM injection molding machine ; 9 oz. HPM injection molding machine; 8 oz. Reed-Prentice injection molding machine; 1 and 2 oz. Van Dorn semi-automatic injection molders. Tablesetting Presses: Stokes Model R, T, & DDS4; Colton Models 2RP and 3RP. Extruders from 1" through 12". Big bed presses 4' x 8', 3' x 6', 3' x 7'. Several sizes of transfer molding presses. We have a complete line of equipment for the rubber and plastic industries, including ovens, blenders, mixers, molding presses, mills, extruders, scrap cutters, etc., etc., Johnson Machinery Co., 683 Frelinghuysen Ave., Newark 5, N. J., BIgelow 8-2500.

FOR SALE: 43—Baker-Perkins #17, 200 gal. jktd. mixers, sigma and duplex blades, many with individual 30 HP motors and drives, power-screw tilts. 2—Baker-Perkins 100 gal., sigma or dispersion blades, jktd. 3—Baker-Perkins 50 gal., sigma blades, jktd. 2—J. H. Day 35 gal. sigma blade. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: Stokes 150-ton Semi-Auto toggle press with panel boards and controls. Reply Box 54291, Modern Plastics.

Machinery wanted

WANTED: Vacuum Metallizing Machine. Must be Large Size. Reply Box 5404, Modern Plastics.

WANTED TO BUY: Used injection molding machines, oven, granulators. One machine or complete plant. Acme Machinery & Mfg. Co. Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900, 102 Grove Street, Worcester, Mass., PLeasant 7-7747, 5222 West North St., Chicago, Illinois, TUxedo 9-1328.

WANTED FOR CASH: 6", 8", 10" or 12" plastic extruder, 2", 4", 6" wire extruder with the crosshead, complete line desired. One hundred, or two hundred horse power chopper. One hundred or two hundred horse power Banberry and Rubber mill. What have you for sale? No dealers, please. Jay Plastics Company, 870 Jefferson Avenue, Washington, Pennsylvania.

MACHINERY WANTED: (1) 75 to 150 ton transfer molding press, self-contained with controls; (2) Electronic pre-heater; (3) Pre-form press, 2 inch or 2½ inch diameter capacity. Delta Plastics Company, Creek Road, Bellmawr, New Jersey, Yellowstone 1-5750.

WANTED TO BUY: Used laboratory laminating press; electric hot plates 0° to 400°, 8" x 8" or 10" x 10". Fiberesin Plastics Company, 756 East Wisconsin Avenue, Oconomowoc, Wisconsin.

Materials for sale

MATERIALS FOR SALE: Molding Powder Utility Grade, Pastel Colors, Toy Colors, Black General Purpose, Medium Impact, High Impact Polystyrenes. Many surplus lots Virgin Pellets. Polystyrenes Attractive Colors. Reed Plastics Corporation, 116 Gold Street, Worcester 8, Massachusetts.

FOR SALE:
Manufacturer offers 720,000 pounds Styrene copolymer, virgin, hi-impact type, suitable for calendering or molding with regular & modified styrenes. Attractive price. Packed 50# bags, pelletized. Reply Box 5403, Modern Plastics.

"TI-CO ABRASIVE COB GRITS for flash removal in airless blast cleaning and tumbling. Lower material cost. Longer life. Less dust. More shine. No electrostatic adherence. Three grade sizes. Ti-Co Industries, Inc., Tipton, Indiana.

Materials wanted

WANTED: Plastic of all kinds—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin & reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

(Continued on page 237)

...GATEWAY TO SAFETY FROM TRAMP METAL

This "handful of trouble" is reason enough for installing an RCA Metal Detector!

A single piece of tramp metal "in hand" is worth thousands of dollars in production time! Any of these small pieces could cause a major plant shutdown if they scored the polished surfaces of the calender rolls. That's why more and more plastics manufacturers and reprocessors are adopting the RCA Electronic Metal Detector as standard equipment on conveyors for exploring raw materials and "pigs."

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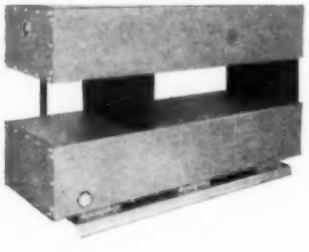

RCA ELECTRONIC METAL DETECTOR

(Continued from page 235)

WANTED: All types of plastic scrap and surplus inventories such as: styrenes, butyrates; acetates, acrylics and polyethylenes in any form. Write, Wire or Phone Collect. Humboldt 1811. Philip Shuman & Sons, 15-33 Goethe Street, Buffalo 6, New York.

PLASTIC SCRAP NEEDED: Acrylic—Butyrate—Acetate All Other Thermoplastics Claude P. Bamberger, Inc. Ridgefield Park, N. J. Telephone: HUbbard 9-5330.

MATERIALS WANTED:—Scrap Polyethylene, films, chunks, pellets. We Pay Cash. Our principal firm is rated in D.&B. AA-A1. Jay Plastics Company, 870 Jefferson Avenue, Washington, Pennsylvania.

WANTED—Molds or Production—Beauty Aids—Hair Accessories—Pickle Forks and Picks—Bar novelties. Submit samples and complete details. Reply Box 5405, Modern Plastics.

Molds wanted

MOLDS WANTED: Wish to purchase Houseware Molds of all types. Please submit catalogue sheets to Modern Plastics, Box—5406.

WANTED: Compression molds for buttons. 17, 18, 20, 22 and 30 ligne self shank buttons, flat or domed face. Molds to be either automatic to mold in the hole or for drilling after molding. Sew thru buttons in staple or fancy shapes also wanted. Also Stokes B2 tablet press. Reply Box 5407, Modern Plastics.

MOLDS WANTED: Used Molds for Toys, Housewares, stationery, etc., wanted for cash. One mold or a hundred. Whole inventories purchased. Alfred A. Rosenthal, 3 Park Row, New York 38, N. Y.

Help wanted

PERSONNEL: Executive—Technical—Sale—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 29 E. Madison St., Chicago, Ill.—Wabash 2-4800. Call, write or wire—in confidence.

HELP WANTED: Young progressive growth company needs experienced Plastics Product Development and Sales Engineer. Unsurpassed opportunity for right man with training in all aspects of plastic extrusions. Solution and paste resins knowledge and injection molding procedures, desirable, but not necessary. B.S. Chemical Engineering required. Sales training helpful. Must be willing to relocate. Excellent area with ideal year around climate. All replies held confidential. If qualified send full resume to Box 5401, Modern Plastics.

PLASTICS ENGINEERS: Technical graduate, preferably ME, experienced in plastics applications related to resin testing and evaluation, extrusion, injection molding and machine design for R & D assignments in expanding plastics group with Nylon-6 project. Challenging opportunity, complete benefit plans. Excellent working conditions. National Aniline Divisions, Allied Chemical Corporation, Hopewell, Virginia.

PLASTICS INJECTION MOULDING: Small, agressive, Midwestern injection moulding company, heavy in engineering know-how and specializing in nylon, desires sales representation in automotive, appliance, and industrial field. We want to cover eastern half of U. S. Most territories open. This is a good opportunity for hard worker. Let's hear from you. Reply Box 5423, Modern Plastics.

PLASTIC COLOR SPECIALIST: Unusual opportunity with established manufacturers of Cellulose Nitrate sheeting. Location in Eastern Massachusetts. Please send complete details. Reply Box 5410, Modern Plastics.

SALES ENGINEER: Established extruder manufacturer seeking young man to sell extruding machines and auxiliary equipment to the plastics industry. Chemical or mechanical engineer preferable. Knowledge of extrusion and sales experience desirable. Requires locating in Southern New England, and must be willing to travel. Excellent opportunity with growing sales force. Combination salary and commission. Reply in confidence to Box 5425, Modern Plastics.

HELP WANTED: New Vacuum Forming Division of reputable Printing organization—seeks experienced model and mold maker—with know how and practical experience to head up division for vacuum forming of transparent blisters—bright future—send resume—plant located in New Jersey. Reply Box 5408, Modern Plastics.

CHEMIST OR CHEMICAL ENGINEER: Medium sized growing company in Midwest requires man with broad background in formulating thermosetting molding compounds. Challenging opportunity. Liberal salary policy. Relocation expenses. Excellent schools and living conditions. Send brief resume. Application held in strict confidence. Reply Box 5413, Modern Plastics.

INDUSTRIAL SALESMAN: Excellent opportunity for technical salesman with protective coatings or plastics sales experience to sell to an expanding market. Prefer chemistry or chemical engineering background. Should be familiar with Eastern United States sales area. Send resume for confidential consideration to: Employment Manager, Archer-Daniels-Midland Company, P O Box 532, Minneapolis 40, Minnesota.

WANTED: Plastic Calendering Foreman Experienced. Must be able take charge entire calendering line in production of light and heavy gauge Vinyl Sheeting. Metropolitan Area. Good opportunity with well established firm. Good salary and fringe benefits. Reply Box 5411, Modern Plastics.

VINYL CHEMIST: Leading flooring manufacturer wants man with experience in calendering vinyl film or sheeting. Excellent opportunity in development and production. Salary commensurate with experience. Replies confidential. American Biltrite Rubber Co., Trenton 2, N. J. Attn: Technical director.

MANUFACTURERS REPRESENTATIVE: To handle fast moving new line of air and water cooled chillers to plastics industry. Units are nationally advertised and manufactured by well established company. Fine opportunity for aggressive rep with some refrigeration know-how to build business with terrific new product! Choice territories available now. Write Dept. M-2 Vic Mfg. Co., 1313 Hawthorne, Mpls., Minn.

WANTED: Technical man thoroughly experienced in extrusion of all thermoplastics to take complete charge of extrusion division. Must be able to handle personnel, die design, set-ups and production. Experience in film desirable. Salary open. State experience in resume. Reply Box 5409, Modern Plastics.

WANTED: Supervisor for compression molding department with at least five years supervisory experience in general precision custom molding. Reply Olympic Plastics Company, Inc., 3471 So. LaCienega Blvd., Los Angeles 16, Calif. Phone TExas 0-1121.

SALES REPRESENTATIVES WANTED: Areas open for machinery representatives to handle new line of take-off equipment. Only aggressive representatives need apply. Reply Box 5428, Modern Plastics.

THERMOPLASTIC SALESMAN: A major producer of Polystyrene, High Impact Styrene and Nylon is interested in discussing an excellent sales opportunity with an alert, experienced man. Thermoplastic background important but not necessarily essential. Location—New York—Chicago—Cleveland. Car—provided. Salary attractive. All replies will be held completely confidential. Please send resumes leading to interview to Box #5412, Modern Plastics

POLYESTER SALES: We require the services of five top men to call on the reinforced plastics trade for the following locations: West Coast, Texas, Florida, Mid West and North East. You will sell Polyester resins, organic peroxides, fiberglas mat, glass cloth and pigments from plants or factory warehouse in your area. Excellent salary and commission to top men. Write or call C. J. Hauck, President American Alkyd Industries, Carlstadt, N. J. GEneva 8-4332.

Situations wanted

SITUATIONS WANTED: Professional Plastics Engr: 10 years experience; now in extrusion design and technical service. Experienced in process construction, field engineering and laboratory development. B.S. in Chem. Engr., married. Top fifth of graduating class. Well grounded in theory; extensive practical experience. Desires responsible position in plastics field. Salary $10,000.00. Reply Box 5416, Modern Plastics.

PLANT MANAGER—Engineer with 18 years of solid experience in all phases of plant management and engineering. Strong tooling and sales background. Experienced in injection and compression molding, extruded sheet production and vacuum forming. Capable of setting up plant, training help and producing top quality production. Reply Box 5414, Modern Plastics.

SITUATIONS WANTED: Want a Sales Manager? Well paid technical sales representative with high volume sales of thermoplastic resins to plastic and rubber industries doesn't know when he's well off. Wants to be a sales manager, an opportunity not available with present employer. Has performed many sales management functions. Age 38. Reply Box 5417, Modern Plastics.

REINFORCED PLASTICS CONSULTANT: MIT Graduate in Chemical Engineering, Business and Engineering Administration. Experienced in all phases of reinforced plastics. Specialist in reinforced polyester molding compounds. Excellent background in new product development, marketing and trouble-shooting production problems. Reginald B. Stoops, 445 Park Avenue, New York 22, N. Y. Tel.: MUrrayhill 8-3900.

SITUATIONS WANTED: PLASTIC CONSULTANT, 13 yrs. excellent experience in plant management, research, development, formulation, production, plant engineering, technical sales service, quality control, and purchasing. Specialist in mfg. of vinyl, polyethylene, acetate, polystyrene, and high impact molding and extrusion compounds; color concentrates; polyethylene blown lay flat tubing, plain & embossed flatfilm; and vinyl & P. E. profiles. Seymour Lewis, 154 Elm Ave., Glen Cove, N.Y.

(Continued on page 240)

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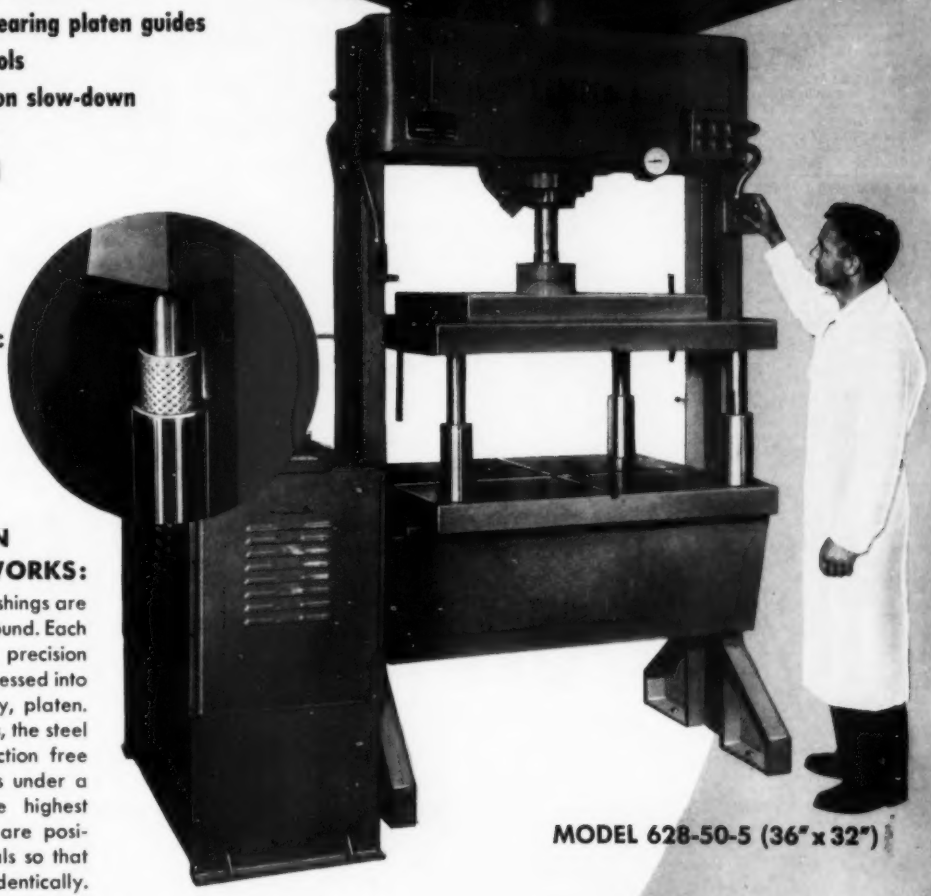

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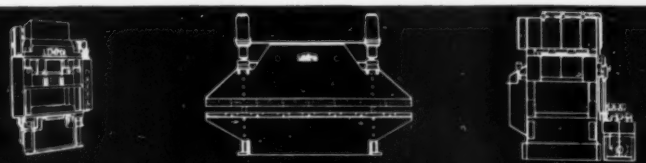

LEMPCO
INDUSTRIAL, INC.
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(Continued from page 237)

PLASTICS PRODUCTS DESIGNER, and Sales Rep. seek position. Heavy experience research and developments with prominent molders, producing variety of Brand Named lines of Consumer products with outstanding sales records. Custom work, Displays, Packaging for large Corp's, USA and Foreign. Technical education, Sales Experience, Selvstarter, Al Idea Man. Reply Box 5415, Modern Plastics.

SITUATIONS WANTED: PLASTIC EXECUTIVE, chemical engineer, 40, with solid background as plant manager, technical director, and production manager experienced with banburys, mills, strainers, and extruders in mfg. of molding and extrusion compounds, flatfilm, blown film, and profile extrusions. Seeks substantial position. Reply Box 5418, Modern Plastics.

PLANT SUPERINTENDENT—TECHNICAL DIRECTOR of large bulk Polystyrene and Polyurethane plants in South America. Extensive consultation work in final applications of these products. 10 yrs. previous experience in the States. Capable of supervising and assuming full responsibilities. Desire supervisory job in Plastics field in the U. S. American citizen. Reply Box 5419, Modern Plastics.

AVAILABLE FOR TECHNICAL SERVICE OR SALES: Chemical Engineer, age 33, with formulating, development, evaluation & technical service experience in P. V. C. film, coated fabric, paint & lacquer. Extensive knowledge of raw materials (pigments, plasticizers, resins, vehicles, stabilizers etc.) salary minimum $11,000. Reply Box 5420, Modern Plastics.

Plastics Engineer with B. S. degree in Chemical Engineering wishes position with resin supplier or chemical manufacturer supplying plastics industry as service engineer or research liaison for sales dept. Twenty four years of plastics experience in vinyl & polyethylene wire and cable coatings, injection & Compression sales & development. Special ability in product development. Reply Box 5427, Modern Plastics.

Miscellaneous

LIQUIDATION SALE: Capac Plastic Inc. Modern Plastic Extrusion And Forming Plant Two Hartig Extruders 4-1/2 inch screw 50 H. P. complete to Automatic Sheet Stacker. Two Aetna Standard Extruders fifty and sixty H. P. complete to Automatic Sheet Stacker. Two Brown Rotory Drape Formers 46 x 72 with Loading, Heating and Forming Units Automatic and Hand Control. Toledo 93-1/2 Double Crank 150 Ton Press 40 x 80 bed area. Cleveland 60 D Double Crank 150 Ton Press 47 & 84 bed area. Bliss #6 Double Crank 125 Ton Press 48 x 84 bed area. All Steel 12 x 48 Plastic Grinder M. D. Formost Plastic Grinder 36" M. D. Auto Vac Former 48 x 74 Bed. Norge Vac Former 49 x 74 Bed. Atlas Vac Former 54 x 54 Bed Kline Vac Former 48 x 78 Bed. Comet Vac Former 35 x 45 Bed. Air Compressors. Vacuum Pumps. Shop Equipment and Office Equipment. Write, telephone or wire for Brochure. Address all inquiries to: Charles S. Moorman, 4204 North Lyndale, Minneapolis 12, Minnesota Telephone: Jackson-2-3351 414 Lafayette Bldg., Detroit 26, Michigan Telephone: Woodward-1-0430.

A UNIQUE CHANCE: German Inventor grants World License great article for sound 4000 cubic centimeter shot-capacity works. Safe basis for new established work since other inventions to be expected. Enterprising firms contact: Richard Niemeier, Munich 12, Ganghoferstr. 18, Germany

WANTED TO BUY: Progressive, expanding middle west custom sheet fabricator wants to acquire established, medium size company making molded reinforced plastics. Send complete information. Strict confidence. Principals only. Please reply Box 5424, Modern Plastics.

Wellknown Swedish manufactory in the plastic branch want to communicate with manufacturer of NYLON INJECTION MOULDING COMPOUND and want the sole right for manufacturing and selling of NYLON INJECTION MOULDING COMPOUND in the Scandinavian countries. Reply Box 5426, Modern Plastics.

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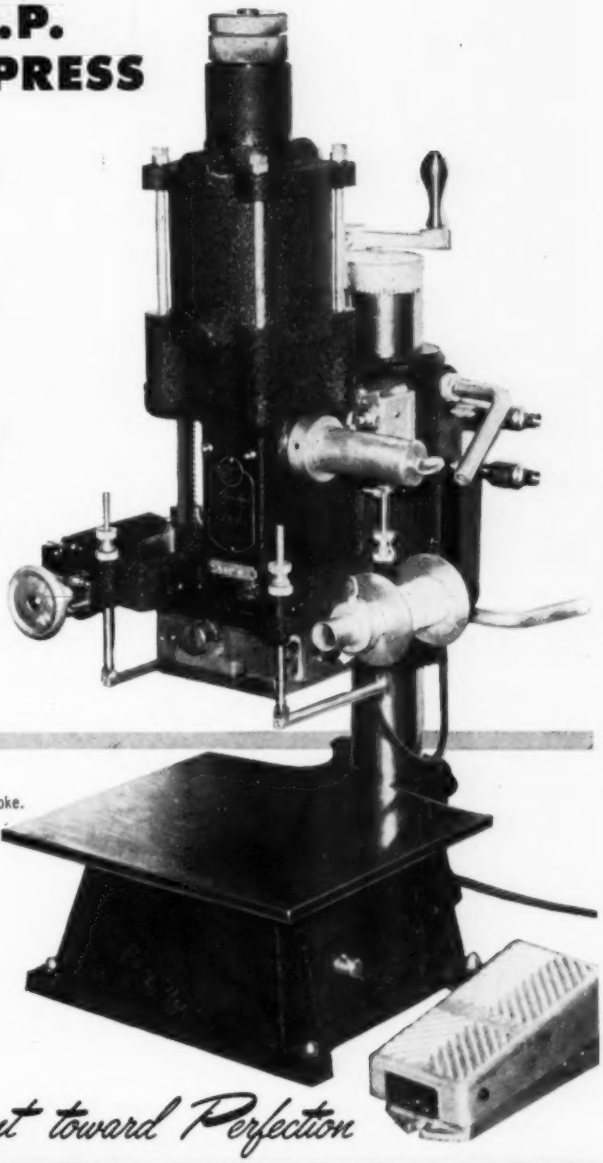

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STATIONARY TABLE:
12" x 11"

AIR PRESSURE:
Not less than 2 h.p. compressor — 80 lb. pressure equipped with 60 gallon tank. Compressor not supplied.
Pressure approximately 19 times line pressure.

ELECTRICAL:
110 volts A.C., unless otherwise specified.

SHIPPING WEIGHT:
220 lbs. Net, 270 lbs. Gross
Head size: 4" x 5"
Die plate size: 4" x 5"
Chase size, inside: 3" x 4"

EQUIPMENT INCLUDES:
lubricator, regulator, strainer and 6 ft. of hose.

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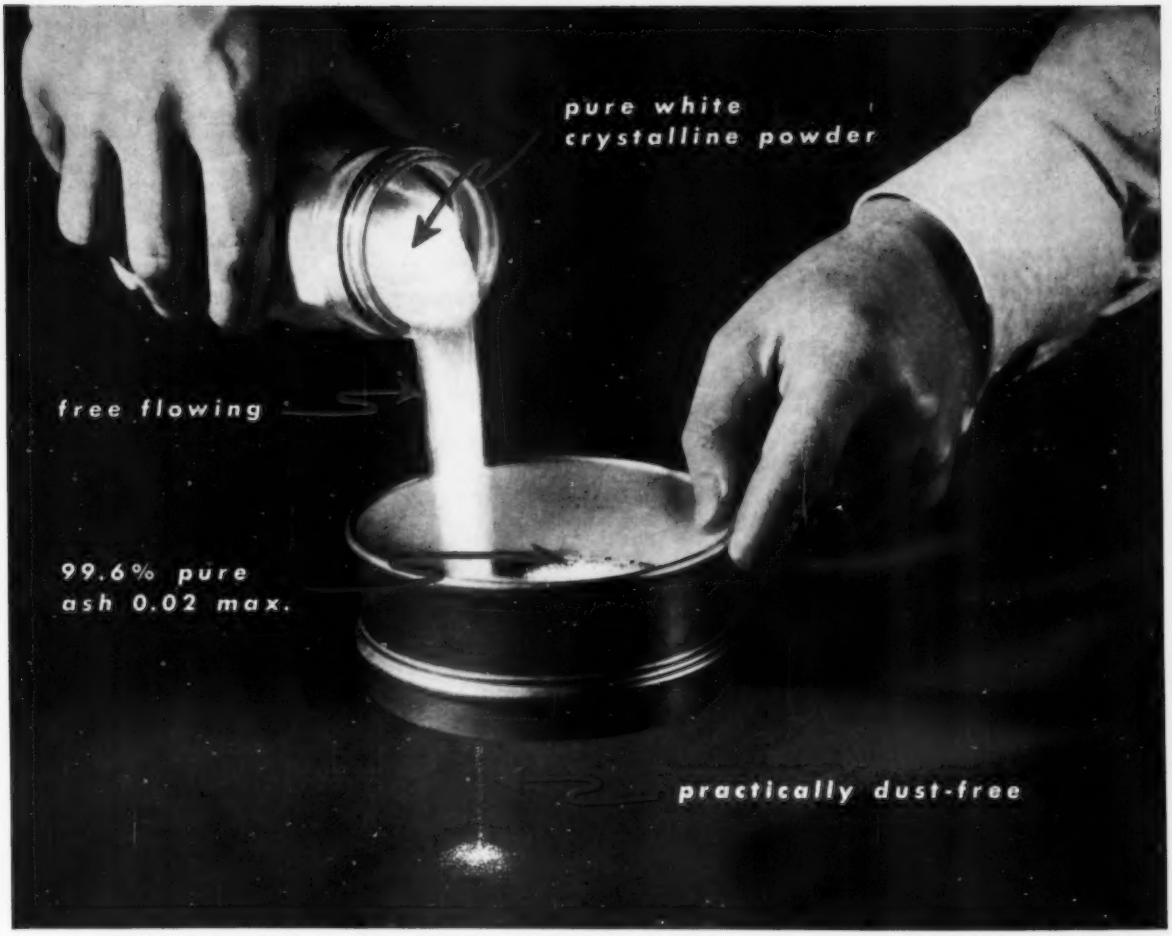

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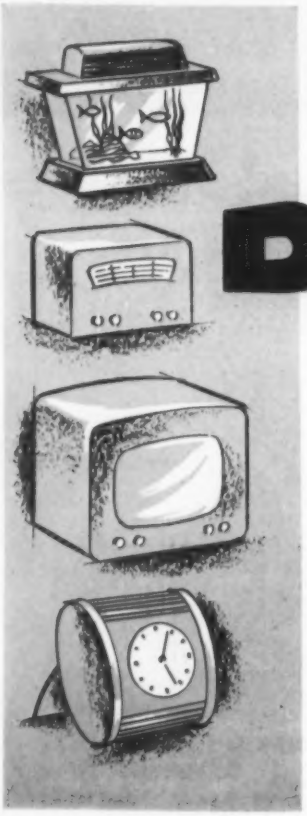

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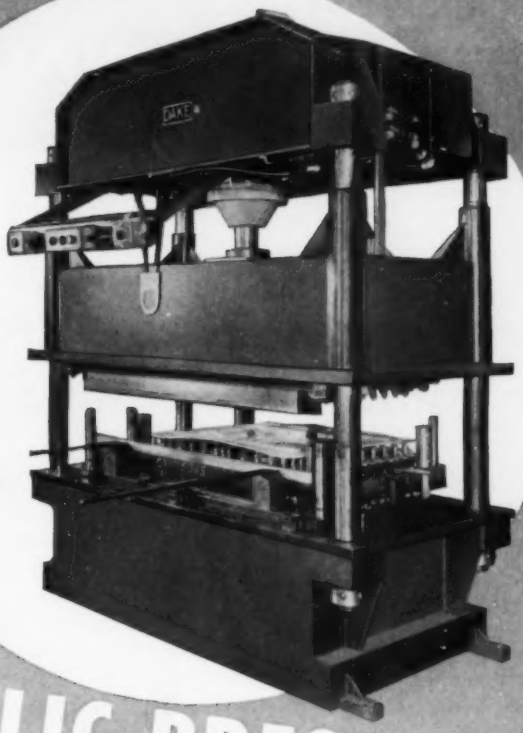

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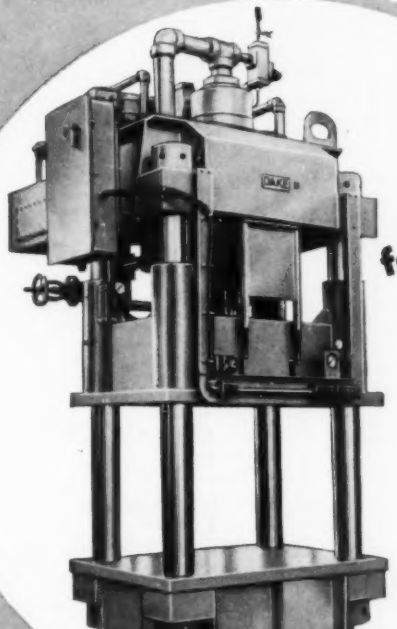

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EDITORIAL

Appliances — new front for attack on plastics

At the beginning of what could be a boom year in room air conditioning, Underwriters' Laboratories, Inc. issued bulletin #484 concerning test procedure for evaluating plastics materials used in room air conditioners. It deals in large part with flammability and if put into effect in its present form may virtually eliminate the use of many present thermoplastics and even some thermoset materials in room air conditioners.

There is much more to the deal. As originally indicated at a meeting between U. L. authorities, room air conditioner manufacturers, and four members of a basic plastic materials committee in Chicago on March 3, this regulation is intended eventually to restrict the use of plastics in refrigerators, radio and television sets, and other home appliances to types that are self-extinguishing or "better."

In its broader market aspects the regulation, as presently conceived, could eventually wipe out more than 150 million pounds a year of plastics sales.

The U. L. declares that combustible plastics are replacing non-combustible materials at an "accelerated" rate. Obviously, from bulletin #484 and the March 3 meeting as reported to MODERN PLASTICS, it is not only a matter of a fire starting in an appliance; it is also a matter of materials in an appliance contributing to the spread of a fire that may have begun elsewhere.

In the past five years probably over 80 million lb. of plastics have been used in air conditioners and at least 300 million pounds in refrigerators. What is the performance record of these units in terms of causing or feeding fires? We have never heard of a fire caused by plastics in any major appliance.

On the other hand there have been cases of deaths caused by internal contact of hot wires with metal housings in television sets, electric drills, and other items.

This is a case where clear heads and rational thinking are needed. Surely it would be disastrous to attempt to deny the American consumer the accepted benefits of plastics in appliances in terms of function, economy, and beauty.

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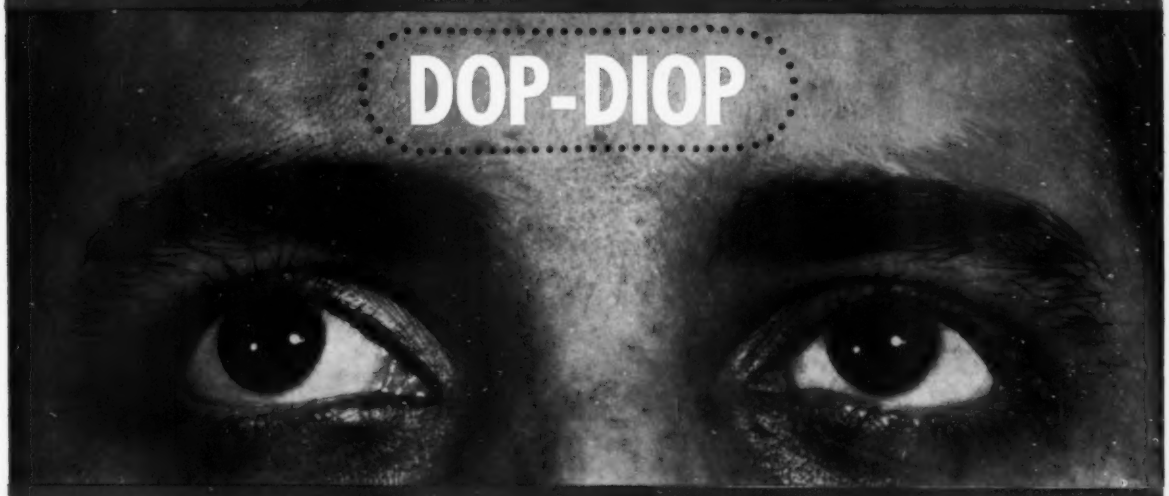

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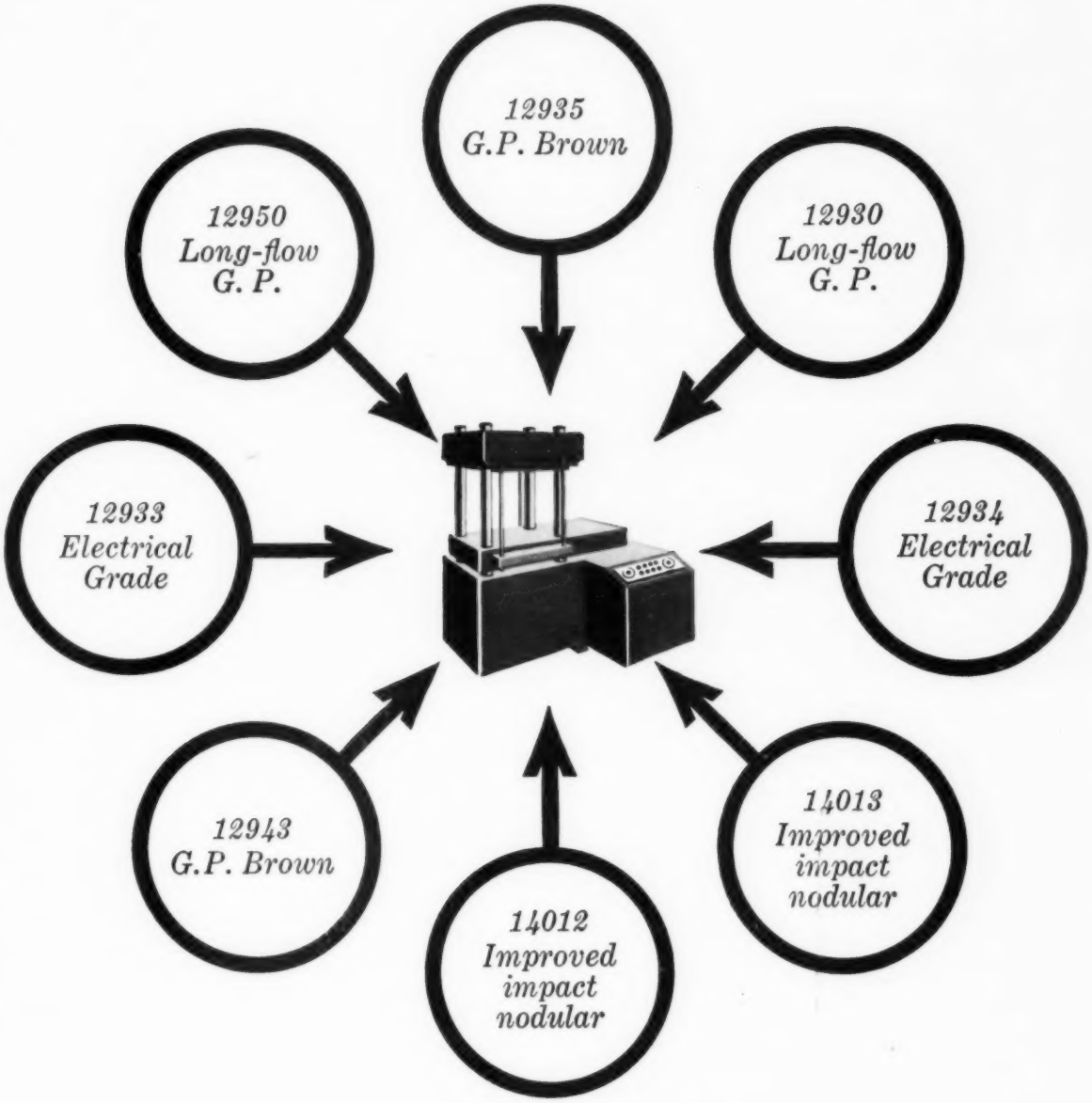

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